

Trudell

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY^{1/}

Core samples from Atlantic Richfield-Mobil Figure 4
 Corehole 31-1 drilled in NW1/4NW1/4SE1/4 (2,634 ft
 N/S and 2,169 ft W/E) of sec 31, T 3 S,
 R 98 W, Rio Blanco County, Colorado

Surface elevation: 7,814 feet
 Mahogany marker depth: 894.6-895.1 feet
 Described interval: 538-2,400 feet

From	To	Description
INTERTONGUED EVACUATION CREEK AND PARACHUTE CREEK MEMBERS		
538.0	541.5	Oil shale: Light to medium brownish gray (2.5Y 6/2-5/2, some 4/2). Moderately distinct to faint laminae. Rare, thin pinched out buff to grayish-brown tuff layers.
541.5	548.2	Mudstone: Buff white to light and rare medium slightly brownish gray. Massive; some faint to distinct, fairly regular to contorted layers and streaks in upper part.
548.2	549.7	Oil shale: Medium to some light and dark brownish gray (2.5Y to 10YR 5/2-4/2, some 6/2 and 3/2, rare 7/2 upper part). Moderately distinct to very faint laminae and streaked bedding. Common fine-grained calcite blebs, streaks, and patches. Some coarse hackly bladed crystal casts with brownish-black organic fillings in upper part.
549.7	550.7	Oil shale: Medium to dark brownish gray (10YR 5/2-3/2). Moderately distinct to faint laminae.
550.7	553.7	Oil shale: Medium to light brownish gray (10YR to 2.5Y 4/2-6/2). Faint to distinct laminae. A slightly irregular 0.1-foot tan tuff band at 551.5. Common fine-grained lacy calcite streaks and stringers from 551.9 to 552.3. Two vertical fractures with very fine bitumen-stained calcite crusts from 552.0 to 553.5. Three fine buff-white earthy tuff stringers in lower 4 inches.
553.7	554.7	Oil shale: Brownish gray to some buff (2.5Y 5/2-6/2, some 7/2). Moderately distinct laminae; common fine loop structures.
554.7	555.7	Oil shale: Buff to some medium brownish gray (2.5Y 7/2-6/2, some 5/2). Distinct to faint laminae; common fine loop structures. Rare fine buff-white earthy streaks.

^{1/} By L. G. Trudell, completed March 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
555.7	560.2	Oil shale: Light to medium brownish gray (2.5Y 6/2-5/2). Faint to moderately distinct laminae and streaked bedding. Common fine gray-buff slightly silty streaks. Some high angle fractures below 558.0; uneven sample split.
560.2	563.3	Siltstone: Light brownish gray (10YR 6/1-6/2). Very faint streaked bedding. Some fine buff marlstone laminae and streaks.
563.3	565.3	Oil shale: Buff to medium brownish gray (2.5Y to 10YR 7/2-4/2, some 8/2 upper part). Distinct to faint laminae and streaked bedding; very common fine loop structures in upper part. A 2-inch light brownish-gray siltstone band at 564.1. Common high angle fractures with some very fine calcite and pyrite coatings in lower half; uneven sample split.
565.3	569.3	Oil shale: Medium to dark and rare light brownish gray (10YR 4/2-3/2, some 5/2, rare 6/2). Moderately distinct to faint laminae and streaked bedding. Common very fine diagonal calcite-filled fractures in upper half. A 0.1-foot light brownish-gray silty tuff stringer at 567.0; some fine to very thin streaks and vermiform stringers in other parts. Irregular to broken core pieces below 568.0; uneven sample split.
569.3	584.6	Siltstone: Gray buff to light brownish gray (10YR 7/1-6/1, some 8/1 and 6/2). Massive to faintly streaked. Some very fine to thick commonly contorted and shredded oil-shale streaks and stringers. Some broken core.
584.6	585.4	Oil shale: Light to dark brownish gray (2.5Y to 10YR 6/2-3/2). Moderately distinct to faint slightly distorted streaks and laminae. Common fine to thick gray-buff to light gray siltstone stringers.
585.4	589.3	Oil shale: Buff to light and some medium brownish gray (10YR 8/2-6/2, some 5/2 and rare 4/2). Fairly distinct to faint streaks and laminae. Common silty streaks. Irregular diagonal calcite-filled fracture at 588.8-589.0.
589.3	592.8	Siltstone: Gray buff (10YR 7/1-8/1). Massive to very faintly streaked.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
592.8	595.0	Oil shale: Buff to medium brownish gray (2.5Y 7/2-5/2). Moderately distinct to faint streaks and laminae; some contorted zones in upper part. Some fine to thick gray-buff siltstone streaks, stringers, and layers. Fractured core in lower part; uneven sample split.
595.0	606.5	Siltstone: Gray buff (10YR 7/1-8/1). Massive to faintly streaked. A thick light brownish-gray oil-shale stringer with faint very fine laminae and streaked bedding at 596.6-596.9; thick to fine shredded stringers and streaks at 598.6-599.2; very finely laminated oil-shale zone at 599.2-599.7 (finely contorted in lower inch); finely laminated light to medium brownish-gray oil shale with some very fine distinct very light buff laminae at 600.4-601.0. Broken core at 601.0-603.0.
606.5	607.2	Oil shale: Buff to medium brownish gray (10YR 7/2-5/2). Faint to distinct very fine laminae and streaked bedding. Some very fine vertical and diagonal dolomite (?) -filled fractures.
607.2	612.0	Siltstone and mudstone: Gray buff to buff (10YR 8/1-8/2 and 7/2). Massive; becoming very finely streaked with marlstone and oil shale in lower part.
612.0	624.7	Siltstone: Gray buff (10YR 7/1-8/1). Massive to faintly streaked. Mostly irregular core pieces and some rubble; uneven sample split. (617.0-618.0 missing).

TOP CONTINUOUS PARACHUTE CREEK MEMBER

624.7	626.0	Oil shale: Buff to brownish gray (10YR 7/2-5/2). Moderately distinct very fine laminae and streaked bedding. Very common fine intersecting calcite-filled fractures.
626.0	628.0	Oil shale: Medium to dark brownish gray (10YR 5/2-3/2). Faint laminae and streaked bedding. Some calcite-filled fractures. Buff silty tuffs at 626.9-627.0 and 627.5-627.7. Uneven sample split.
628.0	631.0	Oil shale: Medium to some dark and light brownish gray (10YR 4/2-5/2, some 3/2 upper part and some 6/2 lower

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		part). Faint to moderately distinct laminae; some fine to thin loop structures and displacements. Common high angle calcite-filled fractures. Broken core at 629.5 -630.3.
631.0	632.5	Oil shale: Very dark to rare medium brownish gray (10YR 2/2-3/2, rare 4/2), rare satiny luster. Faint laminae and streaked bedding. A fine gray-buff tuff layer at 631.5 and a thick stringer at 631.9-632.1. A very thin prismatic calcite layer at 631.6 and a 1/2-inch layer at base. Some calcite-filled fractures in lower part.
632.5	633.5	Oil shale: Dark to medium brownish gray (10YR 3/2-5/2 and 5/3). Faint to distinct laminae; some fine to thin loop structures.
633.5	638.5	Oil shale: Medium to light and some dark brownish gray (10YR to 2.5Y 4/2-6/2, some 3/2). Distinct to some faint laminae; common fine loop structures. Some calcite-filled fractures. Some thin buff to grayish-brown tuff streaks in lower half foot.
638.5	640.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 5/2 and 2/2. Faintly laminated. A very thin layer of fairly coarse crystalline calcite (and quartz?) at 639.5. Common fine tuff streaks in lower 2 inches.
640.0	641.5	Oil shale: Very dark to medium brownish gray (10YR 2/2-4/2), rare satiny luster. Very faintly bedded to faintly laminated. Rare very fine calcite-filled fractures.
641.5	642.8	Oil shale: Dark to medium brownish gray (10YR 3/2-5/2, some 2/2 upper part). Faint to moderately distinct laminae; some fine to thin loop structures. Rare fine to thin, tan to brownish-gray analcite streaks, lenses, and layers.
642.8	645.4	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, rare 5/2). Faintly laminated. Rare fine analcite streaks and layers.
645.4	646.5	Oil shale: Very dark to some medium brownish gray (10YR 3/2-2/2, some 4/2 upper part), some satiny to resinous luster. Faintly laminated to very faintly streaked.

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
646.5	647.7	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2 upper part), rare satiny luster in upper part. Faint to moderately distinct laminae. Some diagonal calcite-filled fractures.
647.7	650.0	Oil shale: Dark to medium and rare light brownish gray (10YR 3/2-5/2, rare 6/2). Distinctly laminated; common fine loop structures.
650.0	653.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, rare 5/2). Moderately distinct to faint laminae; common fine loop structures in upper part. A thin analcite layer at 652.2. Irregular core pieces in lower foot; uneven sample split.
653.0	666.2	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2). Faint to moderately distinct laminae. Rare fine tan to gray-buff silty tuff streaks and thin lenses; a 2-inch grayish-brown tuff with very fine wavy oil-shale streaks at 653.5. Occasional very fine high to low angle calcite-filled fractures from 659.0 to 665.0. Fine slightly prismatic horizontal calcite seams at 661.6 and 663.4.
666.2	667.3	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, rare 5/2). Faint laminae and streaked bedding. A very fine vertical calcite-filled fracture in lower half.
667.3	668.8	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2). Faint to moderately distinct laminae. Two very fine vertical calcite-filled fractures in upper 0.6 foot. A fine horizontal calcite seam at 667.9. Rare fine grayish-brown tuff streaks.
668.8	669.8	Oil shale: Medium to some dark brownish gray (10YR 4/2-5/2, some 3/2). Faint very fine laminae and streaked bedding. A vertical calcite-filled fracture extends through interval. A very regular 0.1 foot massive grayish-brown dolomite (?) band at 669.2. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of massive grayish-brown band from 669.2 feet: X-ray - dolomite, calcite, quartz, analcite, feldspar. </div>

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
669.8	672.8	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 2/2 lower part). Faint to moderately distinct laminae; some fine loop structures. High angle calcite-filled fractures in upper half. A very fine horizontal calcite seam at 672.1.
672.8	673.9	Oil shale: Medium to some dark and light brownish gray and rare buff (10YR 5/2-4/2, some 3/2 and 6/2, rare 7/2 near top). Distinctly laminated; rare fine to thin loop structures and displacements. Abundant very fine buff earthy streaks, lenses, and specks. Fine horizontal calcite seams at 673.1, 373.5, and 373.8. A regular 0.1-foot massive grayish-brown band at base (like 669.2). [Sample of oil shale with very fine buff streaks and lenses from 673.4 feet: X-ray - dolomite, calcite, quartz, analcite, feldspar.
673.9	675.9	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 5/2 mostly in upper part, rare 2/2). Fairly distinct to faint laminae. Abundant very fine buff streaks and specks. Very fine calcite seam at 674.4.
675.9	677.9	Oil shale: Medium to dark and rare light brownish gray (10YR to 2.5Y 4/2-3/2, some 5/2 and rare 6/2 in lower part). Faint to moderately distinct laminae; common fine loop structures and displacements in lower part. Fairly abundant very fine buff streaks and specks. A thin buff earthy silty porous tuff layer at 676.7 and two fine layers at 677.7. Finely contorted bedding in lower half inch.
677.9	678.1	Tuff: Medium to light gray (N5-6; very slight 5YR tint), silty textured. Very faintly streaked bedding to massive. Regular sharp contacts at top and bottom. Some <u>very</u> fine pyrite specks and streaks. [Sample of gray tuff from 678.0 feet: X-ray - quartz, dolomite, feldspar, ferroan, pyrite.
678.1	680.9	Oil shale: Light to dark brownish gray (10YR to 2.5Y 6/2-3/2). Moderately distinct to faint laminae; common fine to thin loop structures. Some very fine buff earthy streaks and gray silty pyritic streaks. A very thin prismatic calcite seam at 679.2. A very thin fine-grained brown tuff layer with fine dense gray noncalcareous mineral streaks at 679.9. Some very fine high angle calcite-filled fractures in lower part.

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-I (Con.)

From	To	Description
680.9	686.3	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 2/2 mostly in upper part and 5/2-5/3 mostly in lower part). Faint to fairly distinct laminae; some fine to thin loop structures and displacements. Diagonal calcite-filled fracture near top. Abundant insect larvae on some parting surfaces.
686.3	688.3	Oil shale: Light to medium and very rare dark brownish gray (10YR 6/2-5/2, rare 4/2-3/2). Faint to some distinct laminae; common fine to rare thin loop structures. Some high angle calcite-filled fractures. A 3-inch massive gray silty tuff band at 687.1 (like 678.0) with a very fine light brownish-gray oil-shale layer one inch from top. Some insect larvae. Sample of light to medium brownish-gray oil shale from 687.6 feet: X-ray - dolomite, quartz, calcite, feldspar, ferroan.
688.3	689.3	Oil shale: Medium and some light to rare dark brownish gray (10YR 5/2-4/2, some 6/2 upper part, rare 3/2). Moderately distinct laminae. Broken core in upper 0.3 foot; vertical fracture with slight buff earthy calcareous coatings and some bitumen-stained patches through rest of interval.
689.3	691.0	Oil shale: Medium to very dark brownish gray (10YR 4/2-2/2, some 5/2), rare satiny luster. Faint to fairly distinct laminae; some fine to thin loop structures. Vertical calcite-filled fracture from top to 690.2. Uneven sample split.
691.0	692.2	Oil shale: Medium and some dark grayish brown to tan and rare buff (10YR 4/2 and 4/3-6/3, some 3/2, rare 7/2). Distinctly laminated; common fine loop structures. Fairly common fine buff to gray calcareous pyritic streaks and lenses. Fine to 1/8-inch calcite-filled high angle fracture in upper 0.6 foot. Uneven sample split.
692.2	693.7	Oil shale: Medium to some light and dark brownish gray (10YR to 2.5Y 5/2-4/2, some 6/2 and 3/2). Moderately distinct to faint laminae; common fine loop structures. Fine tan silty to blebby analcite layer at 693.3.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Slightly irregular 0.1-foot buff silty and slightly earthy tuff at base.
		Sample of buff tuff from 693.7 feet: X-ray - dolomite, feldspar, analcite, pyrite, quartz.
693.7	694.9	Oil shale: Light to very dark brownish gray (10YR 6/2-2/2), rare satiny luster. Distinctly laminated; common fine to thin loop structures and displacements. Fine buff earthy streaks in loop structures at 694.3.
694.9	696.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faintly laminated; some fine to thin loop structures. Fractured and broken core in upper half foot; uneven sample split.
696.0	698.0	Oil shale: Light to dark brownish gray (10YR 6/2-3/2). Distinct to faint laminae; common fine to thin loop structures. Some very fine gray pyritic streaks. A fine tan analcite layer near top. Some insect larvae?
698.0	700.0	Oil shale: Medium and some light to rare dark brownish gray (10 to 7.5YR 5/2-4/2, some 6/2, rare 3/2). Moderately distinct to faint laminae and streaked bedding. Fairly abundant fine buff to gray, dense to silty streaks, lenses, and rare layers. Fine high angle calcite-filled fracture from 699.4 to base.
700.0	701.0	Oil shale: Medium to some light and dark brownish gray and rare buff (10 to 7.5YR 4/2-5/2, some 6/2 and 3/2,, rare 7/2 and 2/2). Faint to distinct laminae; some fine loop structures. Rare fine gray to brown, dense to silty lenses and layers. Some insect larvae? Calcite-filled fracture continues to 700.7.
701.0	702.0	Oil shale: Medium to very dark and rare light brownish gray (10 to 7.5YR 4/2-2/2, rare 5/2-6/2 and 6/3), rare very slight satiny luster. Faint and rare distinct laminae; common fine loop structures. A very fine buff to white silty layer at 701.2
702.0	704.0	Oil shale: Medium and some dark to light brownish gray (10YR 5/2-3/2 upper part to 5/2 and 6/2 lower part). Fairly distinct to faint laminae; common fine loop structures. Some fine to rare thin gray to buff silty streaks and lenses. Common insect larvae and/or plant trash.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
704.0	705.0	Oil shale: Medium and rare dark brownish gray to buff (10YR 5/2-7/2, some 4/2, rare 3/2). Faint to distinct laminae; common very fine loop structures. Some fine gray streaks. Irregular fractured core pieces with muddy coatings in upper half; uneven sample split.
705.0	706.0	Oil shale: Light to rare dark brownish gray and buff (10YR 6/2-5/2, some 4/2, rare 3/2 and 7/2). Faint to distinct laminae; rare fine loop structures and displacements. Rare fine dense gray streaks and laminae. Some insect larvae?
706.0	707.4	Oil shale: Medium to some light and dark brownish gray (10YR 4/2-5/2, some 6/2 and 3/2). Faint very fine laminae in distinct thin to thick lighter and darker zones; common fine to 1/2-inch loop structures. Some very fine buff-white to gray-buff streaks and specks and rare very fine layers.
707.4	708.5	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2, rare 3/2), common satiny to rare resinous luster. Very faintly laminated; some fine loop structures. Few fine buff to tan tuff laminae in upper part and a 1/2-inch band at 708.0. Some very fine pyrite streaks and blebs in middle part. <div style="margin-left: 40px;">Samples of very dark brownish-gray to black oil shale from 708.2 feet: X-ray - dolomite, quartz, feldspar, pyrite, calcite, ferroan.</div>
708.5	709.1	Oil shale: Dark to some medium brownish gray (10YR 3/2 some 4/2, and 2/2). Faint very fine laminae; some fine loop structures. Some very fine pyrite (?) specks and streaks in upper part. Rare very fine tan dolomite streaks and layers in lower part.
709.1	710.5	Oil shale: Medium to light and some dark brownish gray (10YR 4/2-6/2, some 3/2, rare 7/2). Faint very fine laminae commonly in distinct thin to thick, lighter and darker zones; common fine to rare thin loop structures. Abundant plant trash (?) on some parting surfaces. Broken core at 709.7-710.0; small friable muddy breccia

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Laramie Energy Research Center, Laramie, Wyoming

May 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		mass on one fragment. High angle fracture with very fine pyrite at 710.0-710.2; few short tight high angle fractures in other parts. Uneven sample split.
710.5	713.4	Oil shale: Medium to light and rare dark brownish gray (10YR 4/2-6/2, rare 3/2). Faint laminae and some streaked bedding in very thick darker and lighter zones; common fine poorly formed loop structures and displacements. Common very fine dense to silty gray streaks. Some plant trash and insect larvae? Diagonal fracture with slight calcite crusts at 711.2-711.5. Fine buff-white friable earthy silty tuff layer at 712.6. Sample of oil shale with very fine dense gray streaks from 710.9 feet: X-ray - dolomite, quartz, analcite, feldspar, pyrite.
713.4	714.7	Oil shale: Dark to medium brownish gray (10 to 7.5YR 3/2-4/2; some 2/2 upper part). Faintly laminated; common fine to thin loop structures. Fine buff earthy to dense crystalline layers at 713.7, 714.1, and 714.3. A very fine horizontal calcite seam at base.
714.7	717.0	Oil shale: Medium to light brownish gray (10YR 4/2 and 5/2 in upper part to 5/2 and 6/2 lower part). Faint to some moderately distinct laminae; common fine loop structures. Abundant very fine gray to buff streaks becoming sparse in lower part. Abundant plant trash (?) and insect larvae.
717.0	720.0	Oil shale: Brownish gray (10YR 4/2-5/2). Faint laminae and streaked bedding. Fairly common fine gray streaks and rare small blebs. Abundant insect larvae. Broken core in upper part; common high angle fracture surface with very slight gray coatings and rare calcite in lower part. Uneven sample split.
720.0	721.3	Oil shale: Medium to light brownish gray (10YR 4/2 and 5/2 upper part to 5/2 and 6/2 lower part). Faintly laminated. Irregular fractured core pieces with some calcite crusts; uneven sample split.

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Laramie Energy Research Center, Laramie, Wyoming

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
721.3	722.5	Oil shale: Very dark brownish gray (10YR 2/2, some 3/2 lower part). Very faint very fine streaked bedding in upper part to faint very fine laminae with rare fine loop structures in lower part. A very fine horizontal calcite seam at 722.1. Two fine tan to buff analcite layers at 722.3-722.4. Few thin light gray granular analcite lenses at base.
722.5	723.5	Oil shale: Medium and some dark brownish gray (10YR 4/2-5/2, some 3/2-2/2). Moderately distinct laminae; common fine loop structures and displacements. Some fine gray-buff to white, silty to earthy lenses. Some tight high angle fractures in upper part. A very fine calcite seam at 723.1.
723.5	725.0	Oil shale: Medium and rare dark to some light grayish brown (10YR 4/2-5/2 and 5/3, rare 3/2 upper part, some 6/2 lower part). Fairly distinct to faint laminae; common fine loop structures and displacements. Abundant fine white lenses in upper part. Rare fine dense gray streaks. Abundant insect larvae on some parting surfaces. Some irregular natural (?) fractures in lower part.
725.0	727.3	Oil shale: Medium and rare dark brownish gray (10 to 7.5YR 4/2, some 5/2, rare 3/2). Faintly laminated; some very fine loop structures and displacements. Rare very fine gray silty pyritic (?) streaks and buff-white earthy lenses. Abundant insect larvae on some parting surfaces. Discontinuous irregular slightly chalky high angle fractures in upper foot.
727.3	728.8	Oil shale: Grayish brown to some tan (10YR 4/3 and 4/2-5/3, some 6/3). Faint to moderately distinct laminae; some very fine loop structures. Abundant insect larvae in upper part. Some thin dense gray-buff to gray lenses at 727.5-727.6. Some fine irregular intersecting calcite-filled fractures at 727.7-727.8 with one fracture extending to 728.4. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of thin dense light gray lens with some oil shale from 727.5 feet: X-ray - dolomite, analcite, feldspar, quartz.</div>

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Laramie Energy Research Center, Laramie, Wyoming

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
728.8	729.8	Oil shale: Black to some medium grayish brown (10YR 1/2-3/2, some 4/2-4/3), some satiny luster. Fairly distinct to very faint, thin to very fine streaks and laminae; some fine loop structures. Rare fine to small gray lenses and blebs with fine grayish-brown rims.
729.8	731.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faint very fine laminae and streaked bedding. Rare fine to small brown silty lenses. Insect larvae and/or plant trash on some parting surfaces. Some fractured and broken core near top.
731.0	733.0	Oil shale: Medium to some dark grayish brown and tan (10YR 4/2-5/2 and 5/3, some 3/2 and 6/3). Faint to distinct laminae; common fine loop structures and displacements in lower part. A thin dense slightly silty tuff (?) stringer at 731.4. Rare very thin buff-white to light slightly brownish gray lenses in lower part.
733.0	735.1	Oil shale: Medium and rare dark grayish brown to tan and some buff, rare black laminae in lower 0.4 foot (10YR 4/3-6/3, some 7/2, rare 3/2-1/2). Distinctly laminated; very common fine loop structures and displacements. Rare fine buff-white streaks in upper part. <div style="margin-left: 40px;">Sample of distinctly laminated grayish-brown to tan oil shale from 733.3 feet: X-ray - dolomite, quartz, feldspar, analcite.</div>
735.1	736.1	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2, some 3/2), common satiny luster. Very faint streaked bedding and some laminae. Rare very fine horizontal calcite seams and streaks.
736.1	737.0	Oil shale: Very dark brownish gray to medium grayish brown (10YR 3/2 and 2/2 upper part to 4/2 and 5/3 lower part). Faint to fairly distinct laminae; some fine loop structures. Fine to thin tan silty lenses at 736.6.
737.0	738.8	Oil shale: Buff and tan to rare dark brownish gray (10YR 7/2 and 6/3-4/2, rare 3/2 lower part). Distinctly

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		laminated; common fine loop structures. Rare very fine buff-white earthy silty layers and streaks.
738.8	740.3	Oil shale: Medium and rare dark brownish gray (10YR 4/2, rare 3/2 upper part, some 4/3-5/3 lower part). Faint to moderately distinct laminae; some fine loop structures upper part. Some fine brownish-gray to gray silty streaks. A fine buff silty dolomitic layer at 739.6.
740.3	741.6	Oil shale: Very dark to medium brownish gray and some black (10YR 2/2-4/2 and 4/3, some 1/2 lower part), common satiny to rare resinous luster. Faint to rare distinct laminae; some fine to 1/2-inch loop structures in lower part. A thin buff coarse blebby-textured tuff (?) stringer at 740.4. Some high angle fracture surfaces with muddy coatings and sparse pyrite in upper part. Some thin buff to brownish-gray silty tuff lenses at 741.5.
741.6	743.4	Oil shale: Brownish gray (10YR 4/2-4/3, rare 5/2 lower part). Faint streaked bedding. Common thin to 1-inch blebby brown stringers from 742.2 to 742.6; some porous streaks with fairly coarse euhedral crystals and rare pyrite in upper stringer. Some irregular fractured core pieces; uneven sample split. <div style="margin-left: 40px;">Sample of brown porous stringer with crystals from 742.3 feet: X-ray - analcite, quartz, calcite, feldspar.</div>
743.4	745.5	Oil shale: Medium to rare light brownish gray (10YR 4/2 and 4/3-5/2 and 5/3, rare 6/2 lower part). Faint to moderately distinct laminae. High angle fractures throughout; uneven sample split.
745.5	747.7	Oil shale: Grayish brown to tan and some buff (10YR 4/3-6/3, some 7/2). Distinctly laminated; common fine loop structures. Fairly common very fine buff to gray streaks in upper part; very rare buff-white streaks in lower part. Few tight high angle fractures.
747.7	748.7	Oil shale: Grayish brown (10YR 5/3-4/3 and 4/2). Moderately distinct to faint laminae; rare fine loop

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		structures. Rare very fine buff streaks in upper part. Very fine buff slightly blebby tuff at 748.0; this buff silty tuff at 748.4; thin pinch-and-swell grayish-brown silty tuff with blebby patches near base.
748.7	749.7	Oil shale: Dark and some medium brownish gray (10YR 3/2, some 4/2-4/3, rare 2/2). Faintly laminated. Diagonal fracture with slight patchy calcite crusts in upper part.
749.7	752.0	Oil shale: Dark to medium grayish brown (10YR 3/2-4/2 and 4/3, common 5/2-5/3 lower part). Faint to moderately distinct laminae. A 0.1-foot pinch-and-swell tan silty tuff stringer at 750.4 and a 2-inch stringer with shredded oil-shale inclusions at 751.2; thin stringers and lenses at 749.8 and 751.4. A very fine calcite seam at 750.2. A fine vitreous black brittle organic streak at 750.6. Some diagonal fractures--rarely with calcite.
752.0	755.4	Oil shale: Medium to some dark and rare light grayish brown (10YR 4/2 and 4/3-5/2 and 5/3, some 3/2, rare 6/2 and 2/2). Faint to fairly distinct laminae; some fine loop structures. A high angle fracture with orange-brown earthy coatings in upper foot; some diagonal fractures with very slight chalky coatings and calcite crusts in middle part. A 2-inch buff silty tuff stringer with porous blebby patches at 753.2; rare small to fine tuff lenses elsewhere. Uneven sample split.
755.4	756.6	Oil shale: Dark and rare medium brownish gray to black (10YR 3/2-1/2, rare 4/2), some satiny to rare resinous luster. Moderately distinct to faint laminae; common fine to 1/4-inch loop structures. Rare very short chalky fractures. Few fine tan tuff lenses near base.
756.6	756.9	Tuff: Tan to buff, silty, porous. Thin tuff streaks and lenses in very dark oil shale in upper inch; 0.2-foot irregular tuff stringer with fine shredded oil-shale streaks in middle; thin zone of very dark oil shale below. Some very fine pyrite in tuff.
756.9	758.9	Oil shale: Medium and rare dark to light brownish gray (10YR 4/2-4/3 and rare 3/2 upper part to 4/2-6/2 lower part). Distinctly laminated; common fine

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		loop structures in lower part. Rare fine to small dense gray lenses. A vertical fracture with slight calcite crusts in upper part; very common very short tight vertical fractures in lower part. Slightly uneven sample split.
758.9	660.4	Marlstone and oil shale: Buff and tan in upper part to light and medium brownish gray in lower part (10YR 8/2 and 6/3 to 6/2 and 5/2). Faint to some moderately distinct laminae. Some tight vertical fractures; irregular fracture with brownish-black varnish-like coatings in lower part. Some fine to thin irregular grayish-brown silty streaks and lenses with very fine light silty-crystalline rims near base. Slightly irregular and possibly slightly unconformable contact with dark oil shale below. Some irregular to broken core pieces; uneven sample split. A 0.2-foot piece of finely streaked dark oil shale at 759.8 is undoubtedly in wrong place; omitted from sample. [Sample of buff to tan marlstone from 759.1 feet: X-ray - dolomite, calcite, quartz, feldspar.
660.4	761.4	Oil shale: Dark brownish gray to some black (10YR 3/2-2/2, some 1/2), common satiny to waxy streaks. Faintly laminated and streaked; few slightly cross-laminated wedges and zones. Rare fine brown silty streaks.
761.4	763.6	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2 in upper part to 10 and 7.5YR 4/2 in lower part); rare satiny to waxy streaks in upper part. Faint to some moderately distinct laminae; some fine loop structures. Rare fine dense grayish-brown streaks and layers. Irregular high angle fracture with some crusty calcite in upper 0.3 foot. [Sample of brownish-gray oil shale from 763.2 feet: X-ray - dolomite, quartz, feldspar, pyrite.
763.6	765.6	Oil shale: Medium and rare dark brownish gray to tan (7.5 to 10YR 4/2-6/2 and 6/3, rare 3/2 near top and bottom). Faint to moderately distinct laminae; common fine loop structures. Several thin to 0.1-foot, commonly pinched out, tan to buff-white, silty and earthy to porous and finely blebby tuff stringers from 763.9 to 764.8. Rare very fine buff to light gray streaks in lower part.

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
765.6	766.8	Oil shale: Very dark to medium brownish gray and some black (10YR 2/2-1/2 from 765.7 to 766.2, 3/2-4/2 in other parts). Faint laminae and streaked bedding; thin distorted slightly cross-laminated zone at 766.2. Some fine blebby brown analcite streaks in middle part.
766.8	767.2	Tuff: Light brownish gray (10YR 6/2), medium sandy to silty textured. Common very fine to 1/2-inch slightly wavy oil-shale streaks and stringers.
767.2	768.8	Oil shale: Dark to medium brownish gray (10YR 3/2 and some 2/2 upper part to 3/2 and 4/2 lower part). Faint to moderately distinct laminae. Occasional fine to thin tuff stringers and streaks as above.
768.8	773.2	Oil shale: Medium to light brownish gray and some tan to buff (10YR 4/2-6/2, some 6/3-7/2). Distinctly laminated; common fine loop structures. Common slightly muddy high angle fractures with rare calcite crusts. White to buff, chalky to earthy tuff with fine oil-shale streaks at 769.8-770.0; some fine to thin tan to buff tuff stringers and streaks in other parts. Uneven sample split.
773.2	773.7	Oil shale: Medium to rare dark grayish brown (10YR 5/3-4/2, rare 3/2). Moderately distinct laminae; common fine loop structures.
773.7	775.1	Oil shale: Dark to some medium brownish gray (10YR 3/2-2/2, some 4/2-4/3 lower part). Faintly laminated; fairly common fine to thin loop structures. Fine gray-buff silty tuff streaks at 774.0; fine to thin tan tuff streaks at 774.9-775.0
775.1	776.0	Tuff: Tan to buff (10YR 6/3-7/2), silty to fine sandy textured. Common fine to thin shredded dark to medium brownish-gray oil-shale streaks and stringers; thick slightly irregular oil-shale zone at 775.2-775.4.
776.0	779.5	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-3/2, rare 2/2). Faint laminae and some streaked bedding. Some fine to thin, tan to buff tuff layers and streaks in upper foot.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
779.5	782.0	Oil shale: Medium to dark grayish brown and rare tan to buff (10YR 5/3-3/2, rare 6/3-7/2 upper part and rare 2/2 lower part). Faint to rare distinct laminae; some irregular slightly bleached patches in lower part. A thin to 1-inch tan tuff stringer at 779.6 and a thin layer at 779.9.
782.0	784.5	Oil shale: As above. Mostly irregular broken core pieces. Very common fine intersecting calcite-filled fractures in upper 0.6-foot. Uneven sample split.
784.5	789.7	Oil shale: Medium to some dark grayish brown (10YR 4/2 and 4/3-5/2 and 5/3, some 3/2 middle part). Faint laminae and streaked bedding; common fine to thin loop structures and some distorted zones in lower part. Buff earthy silty tuff stringer at 785.8-786.0. Few very fine high angle calcite-filled fractures from 786.7 to 788.0; very fine tight lacy fractures with dark gray and buff-white fillings at 789.1-789.4.
789.7	791.0	Oil shale: Medium to dark grayish brown (10YR 4/2 and 4/3-3/2, rare 2/2). Faintly laminated and streaked; some fine to thin loop structures.
791.0	793.2	Oil shale: Grayish brown to some tan and buff (10YR 4/2 and 4/3-5/3, some 6/3-7/2). Faintly laminated; very common fine loop structures and displacements. A thin brown sandy-textured tuff stringer at 791.4 and a very regular 1-1/2-inch buff silty and earthy band at 791.9. Very fine diagonal calcite-filled fracture in lower 3 inches. Some irregular fractured core pieces in upper part; uneven sample split.
793.2	794.0	Oil shale: Medium to very dark brownish gray (10YR 5/2-2/2). Distinct to faint streaked bedding. Very fine high angle calcite-filled fracture from top to 793.8; irregular mass of very fine lacy calcite-filled fractures in lower 0.2 foot.
794.0	795.0	Oil shale: Medium to dark grayish brown (10YR 4/2 and 4/3-3/2, some 5/3 and 2/2). Faintly laminated and some distinctly streaked. Mostly large irregular fractured core pieces; some calcite-filled fractures. Uneven sample split. (Footage correction; sample consists of about 3 feet of core.)

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
795.0	797.0	Oil shale: Grayish brown (10YR 4/2 and 4/3-5/3). Faintly laminated; common fine loop structures. A 0.1-foot grayish-brown to tan fine sandy-textured tuff at 795.1. A diagonal calcite-filled fracture at top; a high angle fracture with patchy calcite crusts and dark organic (?) patches in lower part.
797.0	799.1	Oil shale: Grayish brown to tan and buff (10YR 4/3-6/3 and 7/2, some 8/2 in middle). Distinct to faint laminae; common fine loop structures. Broken core with rare vuggy fragments in lower half; uneven sample split.
799.1	800.5	Oil shale: Medium to dark grayish brown (10YR 4/3 and 4/2-3/2, rare 2/2). Moderately distinct laminae and streaks in upper part to very faint bedding in lower part. Some very fine medium to low angle calcite-filled fractures in middle part.
800.5	801.8	Oil shale: Dark brownish gray (10YR 3/2-2/2). Faint laminae and streaked bedding; some fine to thin loop structures and displacements.
801.8	804.7	Oil shale: Dark to medium grayish brown (10YR 3/2-4/3, some 2/2 upper part). Faint streaked bedding and some laminae.
804.7	806.8	Oil shale: Grayish brown to tan and some buff (10YR 4/3-6/3, some 7/2). Faint to fairly distinct laminae; common fine loop structures and displacements. Fractured core with fine drusy calcite in lower part; uneven sample split.
806.8	807.9	Oil shale: Grayish brown (10YR 4/3-5/3). Fairly distinct laminae; common fine loop structures and displacements. Broken core with drusy calcite in upper part; some tight calcite-filled fractures in middle. Some fine distinct buff-white earthy and silty streaks in lower part.
807.9	808.9	Oil shale: Medium to some dark grayish brown (10YR 4/3, some 3/2-2/2 lower part). Faintly laminated; some fine loop structures. High angle fracture with blue-gray coatings and drusy calcite patches below 808.2.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
808.9	809.9	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2 and 4/3). Faint to moderately distinct laminae; common fine to thin loop structures. Irregular high angle fracture with some calcite patches from top to bottom. Thin brown very fine sandy-textured tuff stringer at 809.1. Uneven sample split.
809.9	811.0	Tuff and oil shale: Light brownish-gray to tan tuff (10YR 6/2-6/3) and medium brownish-gray oil shale (10YR 5/2-4/2). Silty to fine sandy-textured tuff with abundant fine oil-shale streaks in upper part; oil shale with irregular tuff stringers in lower part. Irregular large fractured core pieces; uneven sample split.
811.0	812.0	Oil shale: Medium to some dark and rare light brownish gray (10YR 4/2-5/2, some 3/2, rare 6/2). Faintly laminated; common fine to thin loop structures and displacements. Very fine diagonal calcite-filled fracture in middle.
812.0	813.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, rare 2/2). Faint laminae and streaked bedding; slightly inclined and distorted in middle.
813.0	815.0	Oil shale: Medium and rare dark grayish brown (10YR 4/3, rare 3/2-2/2). Faintly laminated to very faintly streaked; finely interfingered medium and dark oil shale at 813.9-814.0. Some thin brown crystalline patches and streaks at 813.5-813.6 and 814.0-814.1. A thin zone of fine dense brown dolomite (?) streaks at 814.8. Diagonal calcite-filled fracture at 813.7-814.0. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of oil shale with crystalline patches from 813.6 feet: X-ray - dolomite, analcite, quartz, calcite, feldspar.</div>
815.0	820.0	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, some 2/2). Faintly laminated and streaked. Occasional fine brown dense to silty-crystalline streaks and blebs.
820.0	825.0	Oil shale: Dark to some medium grayish brown (10YR 3/2-2/2, some 4/2-4/3), rare satiny luster. Faint streaked

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		bedding to some moderately distinct laminae. Rare brown to tan, silty to slightly earthy streaks.
825.0	827.0	Oil shale: Dark to medium grayish brown (10YR 3/2-4/3, some 2/2 upper part). Moderately distinct laminae to very faint streaked bedding. Rare fine gray streaks. Sample of dark to medium grayish-brown oil shale from 826.4 feet: X-ray - dolomite, quartz, calcite, aragonite, feldspar, analcite.
827.0	829.0	Oil shale: Medium to dark grayish brown (10YR 4/3 and 4/2-5/3 upper part to 3/2 lower part). Faintly laminated to very faintly streaked. Very fractured zone with calcite fillings and some earthy porous crushed oil shale at 827.3-827.5; common fine intersecting calcite-filled fractures from 827.6 to 828.4.
829.0	831.1	Oil shale: Dark to medium grayish brown (10YR 3/2-4/2 and 4/3). Faintly streaked to laminated. A 0.1-foot buff to gray silty tuff stringer at 829.4. Sample of tuff from 829.4 feet: X-ray - analcite, calcite, feldspar, quartz, pyrite.
831.1	832.5	Oil shale: Medium and rare dark grayish brown to tan (10YR 4/3-6/3, rare 3/2). Distinct to faint laminae; common fine loop structures and displacements. Some irregular tight to slightly open high angle fractures with calcite below 831.7.
832.5	835.5	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, some 2/2). Moderately distinct to faint laminae and some very faintly streaked zones. Some high angle calcite-filled fractures. Thin tight dark brownish-gray silty to very fine blebby-textured layers at 833.1 and 833.4.
835.5	837.5	Oil shale: Medium to dark grayish brown (10 to 7.5YR 4/3-3/2, some 5/3 lower part). Very faint streaked bedding to moderately distinct laminae; common fine loop structures in lower part. Irregular vuggy (?) parting surfaces at 836.1.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
837.5	839.7	Oil shale: Medium and some dark grayish brown to tan (10YR 4/3-6/3, some 3/2). Distinctly laminated; very common fine loop structures and displacements. Thin dense brownish-gray to gray lenses and streaks at 837.6 and 838.9. Some high angle calcite-filled fractures in lower part. Sample of oil shale with small dense brownish-gray lenses from 838.9 feet: X-ray - analcite, dolomite, quartz, feldspar, calcite.
839.7	841.7	Oil shale: Medium and rare dark grayish brown to buff (10 to 7.5YR 4/3-7/2, some 8/2, rare 3/2). Very distinct laminae becoming faint below 841.0; common fine loop structures and displacements. Some high angle fractures with calcite. Some broken core in lower part; uneven sample split. Sample of very distinctly laminated oil shale from 840.2 feet: X-ray - dolomite, quartz, feldspar, calcite, analcite.
841.7	845.3	Oil shale: Dark to medium grayish brown (10 to 7.5YR 2/2-4/3). Faint to moderately distinct laminae; common fine to thin loop structures and displacements. Some discontinuous tight high angle fractures in lower foot.
845.3	848.0	Oil shale: Medium to some dark grayish brown (10 to 7.5YR 4/3-5/3, some 3/2). Fairly distinct to faint laminae; some fine loop structures and displacements. Few short tight high angle fractures; irregular high angle fracture with patchy orange-buff earthy coatings at 846.2-846.7.
848.0	848.6	Oil shale: Medium to very dark grayish brown (10 to 7.5YR 4/3-2/2). Faintly laminated; rare fine loop structures and displacements.
848.6	849.2	Oil shale: Very dark brownish gray (10YR 2/2-3/2), common slight satiny luster. Faint very fine laminae; rare fine to thin loop structures.
849.2	851.0	Oil shale: Very dark to medium grayish brown (10 to 7.5YR 2/2-4/2 and 4/3). Faint to moderately distinct laminae and some bands; rare fine to thin loop structures.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
851.0	852.0	Oil shale: Dark to medium grayish brown (10YR 3/2-4/3, some 2/2). Moderately distinct to faint laminae. Rare fine gray pyritic streaks and very small dense gray blebs.
852.0	854.9	Oil shale: Medium to dark grayish brown (10 to 7.5YR 5/3-3/2, some 2/2). Faint laminae in very thick medium and dark zones; common fine loop structures in lower part.
854.9	855.9	Oil shale: Medium to some dark grayish brown (10YR 5/3-4/3, some 3/2, rare 2/2). Fairly distinct laminae; common fine loop structures. Very fine high angle calcite-filled fracture from top to 855.3.
855.9	857.0	Oil shale: Medium and rare dark grayish brown to buff (10YR 4/3-7/2, rare 3/2). Distinctly laminated; common fine loop structures and displacements. Rare fine dense gray to gray-buff laminae, streaks, and lenses. <div style="margin-left: 40px;">Sample of oil shale with gray lenses from 856.8 feet: X-ray - dolomite, quartz, feldspar, calcite, analcite, pyrite.</div>
857.0	858.0	Oil shale: Medium to dark grayish brown and some tan (10YR 5/3-3/2, some 6/3 upper part, rare 2/2). Distinctly laminated; common fine loop structures and displacements. Some very fine tight high angle calcite-filled fractures. Some very thin dark gray to brownish-gray silty lenses at 857.9.
858.0	858.8	Oil shale: Dark brownish gray to some black (10YR 3/2-2/2, some 1/2), some satiny to resinous luster. Faintly laminated; some fine to thin loop structures. Some thin brownish-gray to buff silty tuff lenses and streaks in upper half. <div style="margin-left: 40px;">Sample of thin tan tuff lens from 858.3 feet: X-ray - Na feldspar, quartz, pyrite.</div>
858.8	859.5	Oil shale: Dark to medium grayish brown (10 to 7.5YR 3/2-4/2 and 4/3, rare 2/2). Moderately distinct to faint laminae. Some very thin buff silty tuff streaks at 858.9.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
859.5	860.5	Oil shale: Medium to dark grayish brown (10 to 7.5YR 4/3-3/2, rare 5/3 and 2/2). Moderately distinct to faint laminae; common fine loop structures. Some very fine tight high angle calcite-filled fractures. Rare fine dark pyritic blebs and streaks. A fine dense brownish-gray stringer at 859.9.
860.5	861.9	Oil shale: Medium to dark grayish brown and some tan to buff (7.5 to 10YR 5/3-3/2, some 6/3-7/2 in middle part, rare 2/2 upper and lower parts). Faint to very distinct laminae; common fine to thin loop structures and displacements mostly in upper and lower parts.
861.9	863.0	Oil shale: Dark and some medium grayish brown to black (10YR 3/2-2/2, some 4/3 and 1/2), some satiny to waxy luster. Faintly laminated; abundant very fine distinct brown to buff blebby layers and streaks from 862.0 to 862.5; common fine to thin loop structures and displacements. A very regular thin gray silty to very fine sandy-textured layer at 862.0. Sample of thin gray tuff layer from 862.0 feet: X-ray - Na feldspar, dolomite, analcite, pyrite, ferroan.
863.0	863.9	Oil shale: Dark to medium grayish brown and some tan (10YR 3/2-5/3, some 2/2 upper part and 6/3 lower part). Faint to distinct laminae; common fine loop structures and displacements. Some high angle calcite-filled fractures in lower part.
TOP OF A-GROOVE		
863.9	865.0	Oil shale: Medium and rare dark grayish brown to tan and buff (10YR 5/3-6/3 and 7/2, some 4/3 and 8/2, rare 3/2). Distinctly laminated; common fine loop structures and displacements. Several very regular high angle fractures with slight calcite crusts and some very fine dark brown organic specks; 1/4-inch displacement on one fracture. Top of A-groove picked at top of 1-inch buff marlstone band.
865.0	867.0	Oil shale: Buff to medium and very rare dark grayish brown (10YR 8/2-5/3, rare 4/3-3/2). Distinctly

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-I (Con.)

From	To	Description
		laminated; common fine loop structures. Some short tight high angle fractures in middle. Some fine to thin zones with abundant very fine black limonite-stained specks in lower part.
867.0	868.0	Oil shale: Buff to medium and some dark grayish brown (10YR 7/2-4/3 upper part, 4/3-3/2 in lower 4 inches). Distinctly laminated in upper part; faint wavy streaked bedding grading to coarse tight to open breccia in lower 4 inches. Rare drusy calcite in lower part. Some thin elongated limonite-stained vugs (?) with white to buff, earthy to granular fillings in middle. Uneven sample split.
868.0	869.0	Oil shale: Grayish brown to tan and some buff (10YR 4/3-6/3, some 7/2). Distinctly laminated; inclined about 25° at top. Buff to tan marlstone with very faint distorted bedding and some fine cavities at 868.5-868.7; very wavy conformable upper surface and slightly wavy lower surface. Some tight discontinuous fractures in upper part.
869.0	871.0	Oil shale grading to marlstone: Buff to tan and some grayish brown (10YR 8/2-6/3 and some 5/3 upper part to 2.5Y 8/2-7/2 lower part). Distinct to faint laminae; common fine loop structures. Some fine gray streaks and irregular slightly gray discolored patches from 869.5 to 870.1. Some medium to high angle natural (?) fractures in lower part.
871.0	873.4	Marlstone: Buff to some light brownish gray (2.5Y to 10YR 8/2-7/2, some 6/2). Moderately distinct to faint laminae; some very fine loop structures and rare displacements. Rare very fine dark pyritic streaks and blebs. High angle fracture with very slight patchy calcite crusts in lower 0.3 foot.
873.4	874.4	Marlstone grading to oil shale: Buff and tan to some grayish brown (10YR 8/2-6/3 upper part to 2.5Y 6/3-5/3 and rare 4/3 lower part). Faint to distinct laminae; common fine loop structures in lower part. Rare dark gray silty pyritic (?) streaks and blebs.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-I (Con.)

From	To	Description
		BOTTOM OF A-GROOVE TOP OF MAHOGANY ZONE
874.4	875.3	Oil shale: Medium to some dark grayish brown and brownish gray (2.5Y to 10YR 5/3-4/2, some 3/2 lower part). Moderately distinct to faint, very wavy and distorted to fairly regular laminae and streaked bedding. Irregular fractured core pieces in upper part. Irregular 1-inch mass of fine tight to slightly open breccia at 875.1. Uneven sample split.
875.3	876.3	Oil shale: Grayish brown (10YR 4/3). Faint streaked bedding and very fine laminae. Fairly common thin to fine dense brown dolomite layers with short vertical fractures.
876.3	877.0	Oil shale: Dark brownish gray (10YR 3/2, some 4/3 and 2/2 streaks). Faint to moderately distinct streaked bedding; rare cross-laminated streaks. Some very fine gray silty pyritic (?) blebs.
877.0	877.4	Oil shale: Very dark to medium grayish brown (10YR 2/2-4/3); some resinous to waxy luster in upper part. Faint to distinct laminae; some fine to 1/2-inch loop structures and displacements. Some thin tan to brown silty tuff streaks in upper part.
877.4	879.4	Oil shale: Medium and some dark grayish brown and brownish gray to tan and some buff (10YR to 2.5Y 4/3 and 4/2-6/3, some 3/2, and 7/2). Distinct to some faint laminae; common fine to thin loop structures and displacements. A 2-inch brown silty tuff nodule and some thin streaks at 878.3. Occasional fine dense gray to white streaks and very thin lenses in lower part.
879.4	880.6	Oil shale: Tan and some buff to medium and rare dark grayish brown (10YR 6/3-4/3, some 7/2, rare 3/2). Distinctly laminated; common fine loop structures. Rare fine gray to gray-buff, dense to silty layers, streaks, and small nodules. Some thin to 3/4-inch pinch-and-swell brown silty to very fine sandy-textured tuff stringers in lower part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
880.6	881.6	Oil shale: Medium to dark brownish gray and grayish brown, some tan to buff in upper part (10YR to 2.5Y 5/2 and 5/3-3/2, some 6/3-7/2 upper part, rare 2/2 lower part). Distinct to faint laminae; some fine loop structures and displacements. Fairly common fine to 3/4-inch brown tuff streaks and layers. Irregular tight vertical fracture with varnish-like coatings in upper 0.3 foot.
881.6	883.1	Oil shale and tuff: Black to rare medium brownish-gray oil shale (10YR 1/2-3/2, rare 4/2), rare satiny to resinous streaks in upper part. Brown to buff (10YR 4/4-7/2) silty to very fine sandy-textured tuff stringers at 881.7-881.9, 882.3-882.7, and 883.0-883.1; some thin tuff streaks, lenses, and stringers in oil-shale zones. Thick tuff in middle has thin interfingered shredded oil-shale stringers at top and very irregular contact at bottom.
883.1	884.1	Oil shale: Dark brownish gray to medium grayish brown (10YR 2/2-3/2 and some 4/2 upper part to 4/3 and some 5/3 lower part). Faint to fairly distinct laminae; some thin to fine loop structures and displacements. Rare thin brown tuff streaks.
884.1	885.1	Oil shale: Medium to some dark grayish brown (10YR 4/3 and 4/2-5/3, some 3/2, rare 6/3). Fairly distinct to faint laminae; rare fine loop structures. Rare thin to fine brown tuff lenses. A thin layer of finely brecciated buff marlstone at 884.7; some tight hackly to lacy fractures below to 885.0 ("curly" parting in fractured zone).
885.1	886.2	Oil shale: Dark brownish gray to black and some medium grayish brown (10 to 7.5YR 3/2-1/2, some 4/3 lower part), some satiny to resinous luster. Faint to moderately distinct laminae; some fine to thin loop structures. Common fine to thin, brownish-gray to tan silty tuff streaks and lenses at 885.3-885.5. A fine dark brown analcite stringer at base.
886.2	887.3	Oil shale: Medium grayish brown to dark brownish gray (7.5 to 10YR 4/2 and 4/3-3/2, some 2/2). Very faintly bedded with some faint laminae. Rare fine dark brown

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		analcite streaks and blebs. Sample of grayish-brown oil shale from 886.8 feet: X-ray - dolomite, quartz, analcite, aragonite, calcite, feldspar, ferroan.
887.3	888.4	Oil shale: Medium brown to some dark brownish gray (10YR 4/3 and 4/4-5/3, some 3/2). Faintly laminated to very faintly bedded. Coarse tight to slightly open breccia in middle. Irregular parting surface with coarse platy boxworks in lower part. Some broken core; uneven sample split. Sample of brecciated oil shale from 887.9 feet: X-ray - dolomite, quartz, analcite, feldspar.
888.4	890.5	Oil shale: Medium to rare dark grayish brown and brownish gray (10YR 4/3-4/2, rare 3/2-2/2, some 5/2-5/3 lower part). Moderately distinct to faint laminae; some fine loop structures. Rare fine brown to tan, dense to silty laminae and streaks.
890.5	891.5	Oil shale: Medium and very rare dark grayish brown (10YR 4/3-5/3, rare 3/2). Faint to moderately distinct laminae; some fine loop structures. High angle fracture with very fine calcite crusts from top to 891.2.
891.5	892.8	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, rare 2/2), rare satiny laminae. Fairly distinct to faint laminae; common fine loop structures. A thin tan dolomite layer with tight vertical fractures with resinous brown coatings at 892.6
892.8	894.0	Oil shale: Medium to dark grayish brown and some tan to buff (10YR 5/3-3/2, some 6/3-7/2). Distinct to some faint laminae; common fine loop structures. Some very fine discontinuous high angle calcite-filled fractures--mostly in lighter zones. Rare very fine buff-white silty streaks.
894.0	894.6	Oil shale: Medium to some dark and rare light brownish gray (10YR 5/2 and 5/3-4/2, some 3/2, rare 6/2). Distinctly laminated; common fine loop structures. Rare discontinuous high angle fractures. Some thin dark gray silty lenses at 894.5.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of distinctly laminated medium to dark brownish-gray oil shale from 894.2 feet: X-ray - dolomite, quartz, feldspar.
894.6	895.1	MAHOGANY MARKER Tuff: Medium slightly brownish gray to gray buff (10YR 5/1-8/1), silty to very fine sandy textured. Two fine oil-shale stringers in upper inch. Broken core in lower half. Sample of light brownish-gray tuff from 894.8 feet: X-ray - analcite, quartz, feldspar, pyrite.
895.1	896.3	Oil shale: Medium and some dark brownish gray to buff (10YR 4/2-7/2, some 3/2). Distinctly laminated; common fine loop structures. Some short tight high angle fractures. Rare fine dense gray lenses.
896.3	897.0	Oil shale: Buff and tan to medium and rare dark grayish brown (10YR 7/2 and 6/3-5/3, some 4/2, rare 3/2). Distinctly laminated; fairly common fine loop structures and displacements. Irregular fractured core pieces at base. Sample of distinctly laminated tan to dark brownish-gray oil shale from 896.5 feet: X-ray - dolomite, quartz, feldspar, ferroan.
897.0	897.8	Oil shale: Medium and some dark grayish brown to some tan and buff (10YR 4/3 and 4/2-5/3, some 3/2 and 6/3-7/3). Distinct to some faint laminae; some fine loop structures. Irregular slightly muddy high angle fracture with very fine crusty to drusy calcite patches from top to bottom; some very fine regular tight high angle calcite-filled fractures in lower part. Uneven sample split.
897.8	898.8	Oil shale: Medium and rare dark grayish brown to buff (10YR 4/3-7/2, some 3/2-2/2 in lower 0.2 foot). Distinctly laminated; rare fine loop structures and displacements. Irregular high angle fracture continues through interval. Very thin to fine, grayish-brown to gray-buff, silty to dense lenses near top and at 898.0; a 3/4-inch pinch-and-swell medium to light brownish-gray, slightly sparry and dense to

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		very fine crystalline and slightly porous tuff at at 898.5. Slightly uneven sample split. [Sample of tuff from 898.5 feet: X-ray - analcite, quartz, feldspar.
898.8	899.8	Oil shale: Black to dark and rare medium brownish gray (10YR 1/2-2/2 upper part to 2/2-3/2 and rare 4/2-4/3 lower part), common satiny to resinous laminae. Very faint to moderately distinct laminae; common fine to thin loop structures. A thin fractured brownish-gray slightly silty tuff layer at 899.0. Rare very fine dense grayish-brown streaks. [Sample of very dark satiny to resinous oil shale from 899.1 feet: X-ray - dolomite, quartz, analcite, feldspar, illite.
899.8	901.8	Oil shale: Dark brownish gray to medium grayish brown (10YR 3/2-4/2 and rare 2/2 in upper part to 4/3-5/3 and some 3/2 lower part). Faint to distinct laminae; common fine loop structures and displacements in lower part. Some thin grayish-brown slightly silty tuff lenses at 900.7. A thin very finely laminated dense buff dolomite layer at 901.5. [Sample of thin buff dolomite layer from 901.5 feet: X-ray - dolomite, quartz, analcite, feldspar.
901.8	902.8	Oil shale: Grayish brown to dark brownish gray (10YR 5/3-4/3 and 4/2 upper part to 3/2-2/2 lower part). Moderately distinct laminae to faint streaked bedding; common fine loop structures and displacements in upper part. Slightly muddy high angle fracture from 902.0 to base.
902.8	903.7	Oil shale: Very dark to medium grayish brown (10YR 2/2-4/2 and 4/3); some satiny to rare resinous luster. Faint laminae and streaked bedding in thick to thin darker and lighter zones; some fine to thin loop structures and displacements. Some small brownish-gray to tan tuff lenses at 903.3 and a 3/4-inch distorted and pinched out stringer at base. High angle fracture continues from above to 903.0.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
903.7	904.5	Oil shale: Very dark to some medium brownish gray (10YR 2/2-3/2, some 4/2), rare satiny luster. Faint to some moderately distinct laminae and streaked bedding; rare fine loop structures and displacements. Some thin to fine tuff streaks at 903.9.
904.5	905.0	Oil shale: Medium to some dark grayish brown (10YR 4/3 and 4/2-5/3, some 3/2-2/2). Faintly laminated with some distinct dark layers mostly near top; common fine to thin loop structures. Rare thin tuff lenses. <div style="margin-left: 40px;">Sample of grayish-brown oil shale from 904.8 feet: X-ray - dolomite, calcite, quartz, feldspar, analcite.</div>
905.0	905.7	Oil shale: Very dark to rare medium brownish gray (10YR 2/2-3/2, rare 4/2), very common satiny to resinous luster. Faintly laminated; common fine to 1/4-inch loop structures.
905.7	906.4	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 4/2 and 2/2), some satiny luster. Faintly laminated; rare fine loop structures.
906.4	907.1	MAHOGANY BED Oil shale: Black to dark and rare medium grayish brown (10YR 1/2-3/2, rare 4/3-5/3); almost all has resinous to waxy luster. Very faintly laminated with some distinct grayish-brown laminae; common fine to 1/4-inch loop structures. <div style="margin-left: 40px;">Sample of very dark resinous to waxy oil shale from 906.7 feet: X-ray - quartz, feldspar, dolomite, analcite, illite, ferroan, pyrite.</div>
907.1	907.9	MAHOGANY BED Oil shale: Dark brownish gray to black and rare grayish brown (10YR 3/2-1/2, rare 4/2-4/3), very common resinous to waxy luster. Faintly laminated; common fine to 1/2-inch loop structure.
907.9	908.6	Oil shale: Medium to very dark brownish gray (10YR 4/2-2/2); very common satiny to resinous and rare waxy luster. Moderately distinct to faint laminae; common fine to 1/2-inch loop structures.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
908.6	909.3	Oil shale: Dark brownish gray (10YR 2/2-3/2) common satiny to some resinous luster. Faint laminae to very faint streaked bedding; some thin to fine loop structures in upper part. Two regular natural high angle fractures with slight muddy coatings below 909.0.
909.3	910.2	Oil shale: Grayish brown to rare black (10YR 4/3-3/2, some 2/2, rare 1/2), rare satiny to resinous luster. Moderately distinct to faint laminae; rare fine to thin loop structures.
910.2	911.5	Oil shale: Dark brownish gray to black (10YR 3/2-1/2), common satiny to resinous luster. Faintly laminated; rare loop structure. A thin pinch-and-swell grayish-brown tuff stringer at 911.3.
911.5	913.6	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2 and 4/3). Faint to some moderately distinct laminae; some fine to thin loop structures and displacements. Few fine brownish-gray tuff streaks at 912.2.
913.6	914.6	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2). Moderately distinct laminae; some fine loop structures and displacements. Rare very fine tuff streaks in lower part.
914.6	916.0	Oil shale: Dark and rare medium brownish gray to some black (10YR 3/2-2/2, some 1/2, rare 4/2 upper part), common satiny to resinous luster. Faint laminae and streaked bedding; rare fine loop structures. High angle fracture from top to bottom; some crusty to drusy calcite near top.
916.0	917.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, rare 2/2). Faint distorted streaked bedding; faintly laminated in lower 2 inches. Hard dense and slightly silty brownish-gray dolomite (?) at 916.6-916.8; some tight high angle fractures with brown to black patchy coatings. Sample of brownish-gray slightly silty dolomite (?) from 916.8 feet: X-ray - analcite, dolomite, feldspar, quartz, illite.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
917.0	919.3	Oil shale: Dark to medium grayish brown (7.5 to 10YR 3/2-4/2 and 4/3, rare 2/2). Moderately distinct to faint laminae and streaked bedding; some fine to thin loop structures and displacements. Some high angle calcite-filled fractures.
919.3	920.3	Oil shale: Medium to some dark grayish brown (10YR 4/3 and 4/2, some 3/2-2/2, rare 5/3 near base). Faint to some distinct laminae and streaked bedding; common fine to thin loop structures and displacements.
920.3	921.3	Oil shale: Very dark to some medium brownish gray (10YR 2/2-3/2, some 4/2), common satiny to resinous streaks. Faint to some moderately distinct streaked bedding.
921.3	922.3	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, some 2/2 near top), some satiny streaks. Faint to moderately distinct streaks and discontinuous laminae.
922.3	922.7	Oil shale: Like 920.3-921.3.
922.7	923.3	Oil shale: Like 921.3-922.3.
923.3	925.0	Oil shale: Medium grayish brown (10YR 4/3-5/3). Faint very fine laminae. Regular to irregular, thick to some thin parting. Some discontinuous tight to open, high to low angle fractures in lower part. A fine vitreous black brittle organic layer at 924.1. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of grayish-brown oil shale from 923.9 feet: X-ray - dolomite, feldspar, analcite, calcite, quartz, ferroan, pyrite. </div>
925.0	926.6	Oil shale: Grayish brown (10YR 5/3, some 4/3 lower part). Faint very fine laminae. Mostly rubble. Some fragments of moderately coarse tight breccia with sparse pyrite. Sample length doubtful; uneven sample split.
926.6	927.6	Oil shale: Medium to very dark grayish brown and rare black (10YR 4/3-2/2, rare 1/2), some satiny streaks. Faint to distinct streaks and laminae; distorted in middle part. Rare fine lacy dark brownish-gray pyritic streaks. Some thin brown tuff streaks at 927.3.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
927.6	929.2	Oil shale: Medium to some dark grayish brown (10YR 4/3 and 4/2-5/3, some 3/2, rare 2/2). Faint to rare distinct laminae; common fine to thin loop structures. Two very fine high angle calcite-filled fractures in lower 0.5 foot.
929.2	929.4	Oil shale: Dark brownish gray (10YR 3/2-2/2); some very fine satiny black streaks. Moderately distinct very fine regular streaked bedding. High angle fracture with muddy coatings continues to base.
929.4	930.2	Oil shale: Grayish brown (10YR 4/3-5/3). Faint to moderately distinct very fine laminae. Common short tight vertical fractures in fine to 1-inch zones.
930.2	930.9	Oil shale: Medium to some very dark grayish brown (10YR 4/3-3/2, some 2/2), rare satiny to resinous luster. Faint to fairly distinct very fine laminae; common fine to thin loop structures in lower part. Few short tight vertical fractures in lighter zones.
930.9	931.9	Oil shale: Dark brownish gray to black and rare medium grayish brown (10YR 3/2-1/2, rare 4/3 lower part), common satiny to resinous luster. Faint very fine laminae becoming moderately distinct near base; some fine to thin loop structures. Thin to 1-inch lenticular light brownish-gray to tan and buff silty tuff stringers at 931.3, 931.4, and 931.8. Sample of very dark satiny oil shale from 931.1 feet: X-ray - quartz, dolomite, analcite, feldspar, illite, ferroan, pyrite.
931.9	933.4	Oil shale: Medium to some dark grayish brown (10YR 4/3-4/2, some 3/2, rare 2/2). Moderately distinct to faint laminae; some fine to thin loop structures and displacements in upper part. Some very fine vertical calcite-filled fractures. Rare fine to thin gray pyritic streaks.
933.4	934.4	Oil shale: Medium to some dark and rare light grayish brown (10YR 4/3-5/3, some 3/2, rare 6/2). Faint to some moderately distinct very fine laminae and streaked bedding. Some short tight vertical fractures. Abrupt change to dark oil shale at base.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of medium to light grayish-brown oil shale from 934.3 feet: X-ray - dolomite, quartz, analcite, feldspar, calcite.
934.4	937.0	Oil shale: Dark to some medium grayish brown (10YR 3/2, some 2/2 upper part and some 4/3 lower part); some very fine satiny black streaks in upper part becoming rare in lower part. Faint streaked bedding; very finely laminated zone with rare small loop structures at 935.7-936.0.
937.0	938.2	Oil shale: Dark to medium grayish brown and rare tan (10YR 3/2-5/3, rare 6/3). Faint to moderately distinct streaked bedding and very fine laminae. Irregular fractured to broken core in upper half; fine porous breccia on parting surface at 937.4. Very common irregular tight fractures with some calcite fillings and rare small angular cavities in lower 0.3 foot. A very fine vitreous black organic streak at 937.8. Uneven sample split.
938.2	939.4	Oil shale: Medium to dark grayish brown (10YR 4/3-2/2), rare satiny luster. Fairly distinct to faint laminae; common fine to thin loop structures. A fine irregular low angle calcite-filled fracture at 938.4. Some small to fine brown slightly silty lenses and streaks at 939.2. Fairly abrupt change to richer streaked oil shale below.
939.4	941.4	Oil shale: Very dark brownish gray (10YR 2/2-3/2); common very fine satiny to resinous streaks. Moderately distinct to faint very fine streaked bedding. Some tight high to low angle fractures near base.
941.4	943.8	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, rare 5/3 lower part). Moderately distinct to faint laminae. Common very fine tight high to low angle fractures with some calcite fillings; common fine to 1-inch displacements and one 3-inch displacement with slight drag folding. Reasonably good sample split.
943.8	945.4	Oil shale: Dark to medium grayish brown (10YR 3/2-4/3, some 2/2 mostly in upper half). Moderately distinct

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		to faint laminae; common fine loop structures. Very fine slightly irregular calcite-filled vertical fracture at 945.0-945.2. Rare fine dense brown to gray streaks and lenses.
945.4	947.2	Oil shale: Medium to dark grayish brown (10YR 5/3-3/2, rare 2/2). Faint to fairly distinct laminae; some fine to thin loop structures. Few short tight calcite-filled fractures in upper part.
947.2	948.5	Oil shale: Medium to very dark grayish brown (10YR 4/3 and 4/2-2/2), rare satiny luster. Moderately distinct to faint laminae; rare fine to thin loop structures. Rare fine to thin grayish-brown tuff streaks and lenses; a 1/2-inch gray-buff to light gray silty and slightly earthy tuff stringer at 948.0 <div style="margin-left: 40px;">[Sample of gray-buff to light gray tuff from 948.0 feet: X-ray - quartz, feldspar, dolomite, analcite, pyrite.</div>
948.5	949.8	Oil shale: Medium to dark grayish brown (10YR 4/3 and 4/2-3/2, rare 2/2). Moderately distinct to faint laminae. Rare very fine dark gray pyritic (?) streaks. Some very fine discontinuous high angle calcite-filled fractures.
949.8	952.0	Oil shale: Buff and tan to medium and some dark grayish brown (10YR 7/2 and 6/3-4/3, some 3/2). Thick distinctly laminated lighter zones and faintly laminated medium to dark zones. Common very fine high angle calcite-filled fractures with rare short open sections in upper part; slightly muddy fracture surfaces with some calcite patches in lower part. Uneven sample split.
952.0	953.0	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, some 2/2). Faint streaked bedding and very fine laminae; some fine loop structures and displacements in lower part. Common very fine tight lacy fractures at 952.3-952.5; some discontinuous tight high angle fractures in other parts. Few thin brown to tan silty tuff (?) lenses at 952.5.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
953.0	954.0	Oil shale: Medium to some very dark grayish brown and some medium brown (10YR 4/3-3/2, some 5/3 upper part, some 2/2-1/2 middle part), rare satiny luster. Distinct to very faint laminae; some fine loop structures and displacements. A thin buff (7.5YR 7/2) silty and partly tuff stringer with some dense brown blebs and pyritic patches at 953.1. Some short tight high angle fractures near base. [Sample of buff tuff from 953.1 feet: X-ray - feldspar, quartz, analcite, dolomite, ferroan.
954.0	954.6	Oil shale: Medium brownish gray to some grayish brown and tan (10YR 4/2-5/2, some 5/3-6/3 near base). Faintly laminated. Common very fine high angle pyrite-filled fractures. A thin buff-white tuff stringer with fine gray pyritic specks at 954.5.
954.6	955.0	Tuff: White to light slightly brownish gray (N9 to 10YR 6/1), silty textured. Massive to faintly variegated. Some fine gray blebs and streaks near top. Broken core; uneven sample split. [Sample of white tuff from 954.7 feet: X-ray - K feldspar, pyrite.
955.0	956.3	Oil shale: Medium and some light brownish gray in upper part to medium and some dark grayish brown in lower part (10YR 5/2-4/2 and some 6/2 to 4/3 and some 3/2). Faint to fairly distinct laminae slightly distorted and displaced near top. Rare fine gray pyritic streaks. Slightly irregular high angle fracture with brown to buff muddy coatings, some calcite patches, and rare bitumen stains from top to bottom. A thin buff-white tuff layer near base. Uneven sample split. [Sample of brownish-gray oil shale from 955.2 feet: X-ray - dolomite, quartz, analcite, feldspar, pyrite, ferroan.
956.3	957.3	Oil shale: Very dark to some medium grayish brown (10 YR 2/2-3/2, some 4/2-4/3), some satiny to resinous luster. Moderately distinct to faint laminae; rare fine to thin loop structures and displacements. A fine gray-buff silty tuff layer at 956.5; some thin

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		to 3/4-inch tan tuff streaks and lenses at 956.9; few small gray-buff tuff lenses at 957.2. Few very fine high angle calcite-filled fractures from 957.0 to 957.2.
957.3	959.3	Oil shale: Medium to dark brownish gray and grayish brown (10YR 5/2 and 5/3-3/2, some 2/2 upper part). Fairly distinct to some faint laminae; some fine loop structures and displacements in upper half. Common short tight high angle fractures. Rare thin tuff lenses in upper part. Rare very fine dark gray pyritic streaks.
959.3	960.3	Oil shale: Medium to some very dark grayish brown and rare black (10YR 5/3-3/2, some 2/2, rare 1/2 lower part); rare satiny luster in lower part. Distinct to faint laminae; common fine to 1/2-inch loop structures and displacements. A thin tan tuff layer with gray pyritic blebs at top.
960.3	961.3	Oil shale: Black to dark and rare medium grayish brown (10YR 1/2-3/2, rare 4/3), common satiny to resinous luster. Faintly laminated; rare fine loop structures. Some slightly muddy natural (?) high angle fractures in middle. Some very thin gray-buff tuff streaks at 961.1. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of very dark satiny to resinous oil shale from 960.8 feet: X-ray - calcite, dolomite, quartz, feldspar.</div>
961.3	963.0	Oil shale: Dark to medium grayish brown (10YR 3/2-4/2 and 4/3, some 2/2). Faintly laminated; some fine loop structures and small distortions. A fine buff tuff stringer at 962.8.
963.0	964.0	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, some 5/3 lower part). Very faint to moderately distinct laminae; rare fine loop structures. Common short tight high angle fractures. Common very fine disseminated crystals in lower 0.2 foot. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of oil shale with very fine disseminated crystals from 963.9 feet: X-ray - dolomite, calcite, quartz, feldspar, pyrite.</div>

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
964.0	965.5	Oil shale: Grayish brown to buff (10YR 4/3-7/2). Fairly distinct to faint laminae; some distorted zones in upper part. Very common tight discontinuous high angle fractures; broken core in middle. Some very fine disseminated crystals as above near base. Uneven sample split.
965.5	966.4	Oil shale: Medium to very dark grayish brown and some black (10YR 4/3-2/2, some 1/2), some satiny to resinous luster in lower part. Faint to fairly distinct laminae; common fine to thin loop structures. Some short tight high angle fractures in upper part.
966.4	967.4	Tuff: Buff (10YR 7/2-8/2), silty and earthy. Faintly variegated with some distorted to contorted streaked bedding. Some fine oil-shale shreds. Common very irregular tight fractures in upper part; broken core and rubble in lower part. Large tuff nodules in rich wavy-bedded oil shale as below in lower 0.1 foot. Partly grab sampled. [Sample of buff tuff from 966.7 feet: X-ray - quartz, K feldspar.
967.4	968.4	Oil shale: Very dark to some medium brownish gray and black (10YR 2/2-3/2, some 4/2 and 1/2), some satiny luster. Faint to moderately distinct laminae--inclined about 30° in upper part; some thin to fine loop structures. Some fine to thin, tan to buff tuff streaks and lenses near top.
968.4	969.8	Oil shale: Dark to medium grayish brown (10YR 2/2-4/2 and 4/3), rare fine black satiny streaks. Faintly laminated in upper 3 inches; faint to fairly distinct streaked bedding in other parts. Rare very fine pyrite blebs. Very rare very fine milky white mineral streaks in lower part.
969.8	970.8	Oil shale: Medium and some dark to rare light brownish gray and tan (10YR to 2.5Y 4/2-5/2, some 3/2, rare 2/2 and 6/2-6/3). Moderately distinct to faint slightly wavy streaked bedding. Some irregular tight to slightly open fractures. Very irregular vuggy (?) parting surface at 969.9. Common fine white spindle-shaped crystals and very fine dark flecks at 970.3-970.4. Broken core with some buff earthy tuff (?) fragments in lower 0.3 foot. Uneven sample split.

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
970.8	973.0	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2). Faint streaked bedding in upper part to moderately distinct laminae with common fine loop structures in lower part; very faintly bedded dense heavy zone at 971.3-971.8. Fairly common tight medium to high angle fractures; some irregular broken core pieces in upper part. Common fine to moderately coarse white milky to chalky crystals at 971.0-971.3 and 971.8-972.0. A small irregular vug with some drusy crystals and very fine pyrite at 971.7. Common fine to thin tan tuff streaks and stringers at 972.2-972.4; a 0.1-foot tan to buff tuff with fine oil-shale stringers and shreds at 972.5. Uneven sample split in upper part. Sample of dark oil shale with coarse white crystals from 971.9 feet: X-ray - calcite, dolomite, feldspar, quartz, pyrite.
973.0	975.0	Oil shale: Medium to some dark grayish brown (10YR 4/3-5/3, some 3/2, rare 2/2). Faint to fairly distinct laminae. Common tight to some open, high angle to irregular fractures; some fine tight to porous breccia. Irregular core pieces in upper part to rubble in lower part; partly grab sampled.
975.0	978.0	Oil shale: Medium to rare dark brownish gray (10YR to 2.5Y 4/2-5/2, rare 3/2-2/2). Faintly streaked to laminated. Rubble and irregular fractured core pieces. Fairly common very irregular buff granular calcite patches, streaks, and stringers. Grab sampled.
978.0	979.5	Oil shale: Medium to light and rare dark brownish gray (2.5Y 4/2-6/2, rare 3/2 upper part). Faint to moderately distinct distorted laminae. Very abundant fine to thin irregular low to high angle buff-white porous granular calcite streaks (discontinuous fracture fillings) and small patches with common pyrite. A very thin brittle vitreous black organic streak at 978.2. Sample of oil shale with fracture fillings from 978.7 feet: X-ray - calcite, dolomite, feldspar, analcite, pyrite, quartz.
979.5	982.0	Oil shale: As above. Mostly rubble and irregular fractured core pieces. Grab sampled.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
BASE OF MAHOGANY ZONE TOP OF B-GROOVE		
982.0	984.0	<p>Marlstone: Buff and gray buff to some light brownish gray (2.5Y 7/2 and 7/1, some 6/2-6/1 and 8/2). Faint distorted laminae and streaks. Some fine buff-white calcite blebs and dark pyritic specks and streaks. Rubble in upper 0.6 foot and some broken core near base; uneven sample split.</p> <p>[Sample of marlstone from 983.2 feet: X-ray - dolomite, calcite, feldspar, quartz, pyrite, illite.</p>
984.0	986.0	<p>Marlstone: Gray buff and buff to rare medium brownish gray (2.5Y 7/1-7/2, some 6/1-6/2 and 8/2, rare 5/1-5/2). Faint very fine smooth laminae. Mostly broken core and rubble with high angle muddy fracture surfaces and rare reddish stains; some low angle fractures with abundant fine pyrite in lower part. Common very fine gray blebs and flecks. Rare fine flat cavities in lower part. Uneven sample split.</p> <p>[Sample of marlstone with very fine gray flecks from 985.9 feet: X-ray - dolomite, feldspar, quartz, pyrite, ferroan.</p>
986.0	987.1	<p>Marlstone and very lean oil shale: Buff to rare medium brownish gray (2.5Y 7/2-6/2, rare 5/2). Faint very fine smooth laminae. Fractured core with muddy coatings and some reddish stains. Fairly common fine pyrite streaks; common very fine gray flecks in upper part. Uneven sample split.</p> <p>[Sample of light to medium brownish-gray oil shale from 987.0 feet: X-ray - dolomite, feldspar, quartz, ferroan.</p>
987.1	988.9	<p>Marlstone and rare oil shale: Buff to rare medium brownish gray (2.5Y to 10YR 8/2-7/2, rare 2.5Y 5/2-4/2). Faintly laminated to very faintly streaked; becoming distorted in lower part. Common very fine white calcite blebs and very fine gray pyritic specks. Broken core in upper 0.4 foot.</p>

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Laramie Energy Research Center, Laramie, Wyoming

May 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of marlstone with fine calcite blebs from 988.5 feet: X-ray - dolomite, calcite, quartz, feldspar, analcite.
		BOTTOM OF B-GROOVE
988.9	989.5	Oil shale: Dark and rare medium brownish gray to some black (10YR 3/2-2/2, some 1/2, rare 4/2), rare fine satiny to resinous streaks. Faint slightly wavy to distorted and displaced streaked bedding. A thin wavy brown very fine crystalline stringer with some pyrite at top. Some irregular tight fractures in distorted zone in lower 0.2 foot. [Sample of fine-grained crystalline stringer with some oil shale from 988.9 feet: X-ray - dolomite, feldspar, analcite, quartz, pyrite.
989.5	990.6	Oil shale: Medium to some dark grayish brown and tan (10YR 4/3-5/3, some 3/2-2/2 and 6/3). Faintly laminated; rare fine loop structures. A large tightly fractured to brecciated oil-shale mass with rare fine to small cavities in a very wavy bedded zone at 989.8-990.1. A thin zone with common fine white calcite streaks and specks at 990.4. A thin tan marlstone layer at 990.5.
990.6	991.6	Oil shale: Black to dark brownish gray (10YR 1/2-3/2), common satiny to resinous luster. Very faint streaked bedding grading to faint contorted laminae in lower part. Some fine to thin light brownish-gray silty streaks and lenses in lower part. Very "curly" parting surface at base.
991.6	992.1	Oil shale: Very dark to medium grayish brown (10YR 2/2-4/2 and 4/3). Faint to distinct, wavy to smooth laminae. Very fine earthy porous oil-shale breccia at 991.7-991.9.
992.1	994.5	Oil shale: Medium and some dark grayish brown to tan and buff (10YR 4/3 and 4/2-6/3 and 7/2; some 3/2, rare 2/2). Distinctly laminated; rare fine to thin loop structures. Vertical fracture surface with tan earthy coatings and some calcite crusts in upper foot; some

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		long to very short tight vertical to diagonal fractures with rare calcite fillings in other parts. Common very fine dark gray specks in upper part.
994.5	995.1	Oil shale: Dark and some medium brownish gray to black (10YR 3/2-1/2, some 4/2), common satiny to resinous luster. Faint laminae with common fine to 1/2-inch loop structures; contorted bedding in lower inch. Diagonal fracture with very fine calcite crusts in upper half. Sample of very dark satiny to resinous oil shale from 994.8 feet: X-ray - dolomite, feldspar, quartz, calcite, pyrite, illite.
995.1	995.5	Tuff (?) and oil shale: Yellowish-buff to tan tuff (2.5Y 7/2 and 7/3-6/3) and oil shale as above. Three quarter-inch tuff at top and 1-3/4 inch tuff at bottom with oil shale between. Common fine wavy oil-shale streaks in tuffs and some fine tuff streaks in oil shale. Sample of tuff with fine oil-shale streaks from 995.4 feet: X-ray - feldspar, dolomite, calcite, quartz, pyrite.
995.5	996.5	Oil shale: Black to grayish brown (10 to 7.5Y 1/2-4/3, some 5/3), some satiny to resinous luster. Faint laminae in distinct thin to thick darker and lighter zones; some fine to thin loop structures and displacements. Some fine to thin orange-brown tuff (?) streaks and lenses near base; rare very fine streaks elsewhere. Sample of oil shale with orange-brown streaks and lenses from 996.4 feet: X-ray - dolomite, feldspar, calcite, pyrite, ferroan.
996.5	997.9	Oil shale: Medium and some dark brownish gray (10YR 4/2-4/3 and some 3/2 to rare 2/2 in upper part to 2.5Y 4/2-5/2 lower part). Faintly laminated. Some tight medium to high angle fractures. A 2-inch buff silty and earthy tuff at 997.3 and a 1-1/2-inch tuff at base.
997.9	999.7	Oil shale: Medium and some dark brownish gray to some tan and buff (10YR to 2.5Y 4/2-5/2 and 5/3, some 3/2 and 6/3-7/2). Fairly distinct laminae. Some tight

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		discontinuous high angle fractures. Rare fine to 1/2-inch gray silty lenses. A 1-inch (?) buff tuff at 999.4 (broken core). Large insect larvae (?) on parting surfaces at 998.6.
999.7	1,000.9	Oil shale: Medium to dark and some light brownish gray (10YR 4/2-3/2, some 5/2-6/2, rare 2/2). Moderately distinct to faint laminae; 3/4-inch contorted zone near base. Abundant very fine dark gray pyritic streaks and specks. Rare fine to 1/4-inch brown to buff lenses. Few discontinuous high angle fractures with calcite crusts at 1,000.2-1,000.4.
1,000.9	1,002.2	Oil shale: Brownish gray to some tan and rare buff (10YR 5/2-4/2, some 6/2-6/3, rare 7/2). Faintly laminated; some discontinuous tapered laminae in middle. Some discontinuous high angle fractures with varnish-like coatings.
1,002.2	1,003.2	Oil shale: Buff and tan to brownish gray (10YR to 2.5Y 7/2 and 7/1-6/3, some 5/2). Faint to rare distinct very distorted and displaced streaks and laminae. Very irregular parting and fracture. Common fine buff-white to gray-buff, silty and earthy porous calcareous streaks and patches. Some very irregular discontinuous fractures with varnish-like coatings in upper part. A 2-inch buff to tan tuff at top; slightly wavy and displaced upper contact and very wavy contorted lower contact. <div style="margin-left: 40px;">Sample of buff tuff from 1,002.3 feet: X-ray - K and Na feldspars, quartz, calcite.</div>
1,003.2	1,004.2	Oil shale: Buff to grayish brown (10YR 8/1 and 8/2-4/3). Faint to distinct laminae in thick to thin lighter and darker zones. Common discontinuous tight high angle fractures with slight pinkish coatings--mostly in lighter zones. Very common very fine white specks in grayish-brown layers. Large "fat" insect larvae on parting surfaces near base. <div style="margin-left: 40px;">Sample of distinctly laminated oil shale with very fine white specks from 1,003.9 feet: X-ray - dolomite, quartz, feldspar, analcite.</div>

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,004.2	1,005.2	Oil shale: Grayish brown to tan and rare buff (10YR 4/3 and 4/2-6/3, rare 7/2 lower part). Faint to some fairly distinct laminae; some 1/2-inch loop structures at 1,004.7. Very abundant very fine white specks and some dark gray pyritic specks in upper part. Abundant tight intersecting fractures with some drusy calcite in upper half; some discontinuous high angle fractures in lower half. A thin buff earthy tuff (?) layer at 1,005.0.
1,005.2	1,006.2	Oil shale: Medium and rare dark grayish brown to some tan (10YR 4/3 and 4/2-5/3, some 6/3, rare 3/2). Fairly distinct to faint laminae. Some very short tight high angle fractures. Some very fine dark gray pyritic specks and streaks. Rare fine buff earthy streaks in lower part.
1,006.2	1,007.2	Oil shale: Buff and tan to grayish brown (10YR 7/2 and 6/3-4/3 and 4/2). Distinctly laminated; rare very fine loop structures. Some discontinuous tight high angle fractures. A thin buff tuff stringer at 1,006.3.
1,007.2	1,008.2	Oil shale: Tan to medium and some dark grayish brown (10YR 6/4-4/3, some 2/2). Distinctly laminated. High angle fracture with patchy calcite crusts in upper 0.3 foot. A thin massive tan to brownish-gray dolomite layer at 1,007.8.
1,008.2	1,009.2	Oil shale: Medium grayish brown and some tan in upper part to dark brownish gray in lower part (10YR 4/3 and 4/2-5/3 and some 6/3 upper part, 10YR to 2.5Y 4/2-2/2 in lower 0.4 foot); some satiny luster near base. Fairly distinct to faint laminae. A very thin gray silty layer at 1,008.3. Few fine dense to earthy buff layers in middle part. Rare small gray silty lenses in lower part. Common very fine lacy buff fractures at 1,008.6-1,008.7. <div style="margin-left: 40px;">Sample of medium to dark brownish-gray oil shale from 1,009.0 feet: X-ray - dolomite feldspar, quartz, aragonite, analcite, calcite, pyrite.</div>
1,009.2	1,011.0	Oil shale: Dark to light brownish gray and some buff (10YR 3/2-6/2, some 7/2). Faint to distinct laminae.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		A 0.2-foot gray to brownish-gray silty tuff with two fine dark oil-shale stringers at top. Some irregular high angle fractures very fine pyrite crystals and some short vertical fractures with varnish-like coatings. Rare fine gray pyritic streaks.
1,011.0	1,012.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faintly laminated. Rare fine dark gray laminae.
1,012.0	1,014.0	Oil shale: Medium to dark grayish brown and brownish gray (10YR 4/3 and 4/1-3/2); few resinous black laminae at 1,012.6-1,012.7. Moderately distinct to faint laminae. A thin brownish-gray tuff layer at 1,012.4.
1,014.0	1,015.0	Oil shale: Buff and tan to medium and rare dark brownish gray (10YR 7/2 and 6/3-4/2, rare 3/2). Faint to some distinct laminae; some distorted and shredded oil-shale stringers in lower part. Some very small to 1-inch irregular silty to very fine sandy-textured lenses in upper part. Few discontinuous high angle fractures with very fine crusty calcite patches and varnish-like coatings in middle. Sample of large buff to gray, silty to very fine sandy-textured lens with some oil shale from 1,014.2 feet: X-ray - Na feldspar, quartz, dolomite, calcite, analcite, pyrite.
1,015.0	1,016.0	Oil shale: Light to rare dark brownish gray (10YR 6/2 and 6/3-4/2 and 4/3, rare 3/2). Distinctly laminated in upper part to faintly streaked in lower part. Rare fine light gray to buff, dense to silty streaks. A thin tan (10YR 6/3-7/4) slightly earthy stringer at 1,015.5.
1,016.0	1,018.0	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-3/2). Moderately distinct to faint streaked bedding; contorted zone at 1,016.6-1,016.8. Irregular fractured core pieces at 1,016.9-1,017.3. A 1/2- x 1-1/2-inch irregular vug with porous earthy filling and limonite-stained platy boxworks at 1,017.4. Sample of oil shale from 1,016.3 feet: X-ray - dolomite, feldspar, calcite, quartz, aragonite, pyrite.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,018.0	1,019.7	Oil shale: Medium to some light and dark brownish gray (2.5Y 5/2-4/2, some 6/2 and 3/2, very rare 2/2). Moderately distinct to faint very fine laminae; some fine loop structures and displacements. A thin buff silty and earthy tuff lamina at 1,018.3. A very fine brittle vitreous black organic streak at 1,018.9. A fine medium to dark gray silty lamina at 1,019.1.
1,019.7	1,020.0	Tuff: Medium gray (N 5-4, slight brown tint). Massive silty textured. Some very fine oil-shale stringers in upper part. Common irregular tight high angle fractures with some patchy brown to black organic coatings. Slightly wavy upper contact and sharp smooth lower contact. [Sample of gray silty tuff from 1,019.9 feet: X-ray - Na feldspar, dolomite, analcite, pyrite, quartz.
1,020.0	1,020.8	Oil shale: Brownish gray in upper part to grayish brown and black in lower part (2.5Y 4/2-5/2 to 10YR 4/3-1/2); common satiny to waxy luster in lower half. Faint to distinct laminae; common fine to 1/4-inch loop structures and some displacements. Common fine orange-tan to buff (7.5YR 6/4-8/3) streaks at base (like 996.4 feet).
1,020.8	1,022.7	Oil shale: Brownish gray to buff (10YR 4/2-7/2, rare 7/1). Distinctly laminated. Some very fine short calcite-filled vertical fractures. Fine dark gray silty laminae at 1,022.1 and 1,022.4.
1,022.7	1,023.7	Oil shale: Light to rare dark brownish gray and some buff (10YR and 2.5Y 6/2-4/2, some 7/2, rare 3/2-2/2). Fairly distinct laminae. Some high and low angle fractures and earthy weathered streaks at 1,023.0-1,023.3. Rare fine to thin, buff to gray silty streaks and lenses in lower part.
1,023.7	1,024.2	Oil shale: Medium to dark grayish brown and some black (10YR 5/3-3/2, some 2/2-1/2 upper part); some resinous luster in upper part. Fairly distinct laminae. Vertical fracture with fine calcite crusts from 1,023.8 to 1,024.0. Some small orange-buff to brown, earthy to very fine granular lenses near base.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,024.2	1,025.6	Oil shale: Grayish brown to black (10YR 4/3-1/2, some 5/3 upper part), common resinous luster. Distinct to faint laminae; common fine to thin loop structures and displacements. Tan to buff, silty to very fine sandy-textured tuff with fine shredded oil-shale stringers at 1,024.9-1,025.1; rare thin streaks and lenses elsewhere.
1,025.6	1,026.8	Oil shale: Medium to dark grayish brown and rare black (10YR 5/3-2/2, rare 1/2), some satiny luster. Moderately to very distinct laminae; common fine to thin loop structures and displacements. Rare fine brown to buff streaks and lenses in upper part. Some small brownish-gray porous fine sandy-textured lenses at 1,026.5. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of oil shale with small brownish-gray lenses from 1,026.5 feet: X-ray - Na feldspar, pyrite.</div>
1,026.8	1,028.0	Oil shale: Light to medium and some dark brownish gray (2.5Y and 10YR 6/2-5/2, some 4/2-2/2). Faint to some fairly distinct laminae; some fine to thin loop structures; 0.1-foot dark zone with very fine streaked bedding at 1,027.4.
1,028.0	1,029.0	Oil shale: Medium to very dark brownish gray and some black (10YR 4/2 and 4/3-2/2, some 1/2, rare 5/2-5/3), rare satiny luster. Moderately distinct to faint laminae; some fine to thin loop structures. Rare fine brown silty lenses. Some 1/2-inch gray silty lenses at 1,028.6. A 1-inch light brownish-gray to buff, silty to very fine sandy-textured tuff band at 1,028.9.
1,029.0	1,030.1	Oil shale: Medium to light brownish gray and rare gray buff (10YR 5/2-6/2, rare 4/2 and 7/1). Faintly laminated. Rare insect larvae. Common high angle fractures--some with abundant pyrite and some with varnish-like coatings. Uneven sample split. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of medium to light brownish-gray oil shale from 1,029.7 feet: X-ray - dolomite, quartz, feldspar, analcite.</div>
1,030.1	1,030.7	Oil shale: Dark to medium grayish brown (10YR 2/2-5/2 and 5/3); some very fine resinous black streaks. Thick

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-E (Con.)

From	To	Description
		to thin dark zones with very fine streaked bedding alternating with lighter faintly laminated zones. Some short tight high angle fractures with varnish-like coatings in lighter zones. A very thin dense dark gray layer at 1,030.3.
1,030.7	1,031.3	Oil shale: Brownish gray (10YR 4/2-5/2, rare 5/3). Faint very fine laminae and streaked bedding; thin slightly distorted and shredded oil-shale stringers near base. A 2-inch irregular lenticular brownish-gray silty mass with dark and light streaks and mottling at 1,031.2.
1,031.3	1,031.4	Oil shale: Black to brownish-gray (10YR 1/2-4/2). Very fine streaked bedding.
1,031.4	1,032.0	Oil shale: Medium and some light brownish gray (10YR and 2.5Y 5/2 and 5/3-4/2, some 6/2). Moderately distinct to faint very fine laminae and streaked bedding. Rare fine dark gray silty streaks.
1,032.0	1,033.2	Oil shale: Dark to rare medium brownish gray (10YR 3/2-2/2, rare 4/2); common fine satiny to waxy black streaks. Moderately distinct to faint streaked bedding. Sample of dark brownish-gray oil shale from 1,032.4 feet: X-ray - dolomite, quartz, feldspar, pyrite, illite.
1,033.2	1,033.8	Oil shale: Grayish brown (10YR 4/3 and 4/2-5/3 and 5/2); rare fine black satiny streaks. Faint slightly distorted and displaced laminae and streaks. A thin brownish-gray silty tuff stringer near base.
1,033.8	1,034.5	Oil shale: Black to dark and rare medium grayish brown (10YR 1/2-3/2, rare 4/3), common satiny to rare resinous luster. Faint to some moderately distinct very fine laminae.
1,034.5	1,035.0	Oil shale: Medium brown to brownish gray (10YR 5/3-4/3 and 4/2, some 4/4); a fine waxy black lamina at 1,034.6. Moderately distinct to faint very fine laminae. Rare

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Laramie Energy Research Center, Laramie, Wyoming

May 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		very fine buff streaks with some pyrite. A 1-inch gray to brownish-gray silty band with abundant very fine disseminated pyrite and some vertical fractures with pyrite at 1,034.9.
1,035.0	1,036.8	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-3/2). Faintly laminated. Occasional fine dark to medium gray silty laminae and streaks.
1,036.8	1,037.8	Oil shale: Dark and some medium brownish gray (10YR 3/2-2/2, some 4/2-4/3); rare satiny luster near base. Faint very fine laminae; rare fine loop structures. Some short open fractures near base.
1,037.8	1,039.5	Oil shale: Medium to light brownish gray (10YR 4/2-6/2). Faint very fine laminae and streaked bedding nearly obscured by very [numerous] irregular tight fractures commonly with fine pyrite. Irregular displaced contact with dark oil shale above; some small angular fragments of dark oil shale "floating" in nearly massive lighter oil shale near top.
1,039.5	1,040.4	Oil shale: Grayish brown to tan (10YR and 2.5Y 5/3 and 5/2-6/3 and 6/2). Moderately distinct to faint laminae. Vertical fracture surfaces with muddy coatings throughout; some short slightly open fractures near base. Uneven sample split.
1,040.4	1,041.4	Oil shale: Grayish brown to rare buff (10YR and 2.5Y 5/3-4/3, rare 6/3-7/2) and some dark brownish gray (10YR 3/2-2/2); some fine resinous to waxy black streaks. Faint to moderately distinct laminae with some fine loop structures; dark finely streaked zones at 1,040.5-1,040.6 and 1,041.0-1,041.2. Some tight discontinuous high angle fractures.
1,041.4	1,042.4	Oil shale: Medium to very dark grayish brown (10YR 4/3 and 4/2 upper part to 3/2 and 2/2 lower part); a thin dark zone with some very fine resinous streaks near top. Moderately distinct to faint very fine laminae. A tight high angle fracture with very fine crystalline calcite from 1,041.5 to 1,042.1. Some small brown dense to silty lenses at 1,041.7.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,042.4	1,044.5	Oil shale: Very dark brownish gray and black in upper part to dark and rare medium grayish brown in lower part (10YR 2/2 and 1/2 to 3/2 and rare 4/3), common satiny to resinous luster. Very faint very fine streaked bedding to faint and some moderately distinct laminae; rare fine loop structures and displacements. A fine gray silty layer at 1,042.6. Some irregular fractured core pieces in lower part; uneven sample split. Sample of very dark resinous oil shale from 1,043.1 feet: X-ray - quartz, calcite, feldspar, dolomite, analcite, pyrite, ferroan.
1,044.5	1,049.5	Oil shale: Grayish brown to tan and buff (10YR and 2.5Y 5/3 and 5/2-6/3 and 7/2). Moderately distinct to faint laminae and streaked bedding. Common high angle fractures with muddy coatings and fine pyrite. Rare insect larvae (?) in upper part. Mostly broken core and rubble; uneven sample split.
1,049.5	1,050.7	Oil shale: Medium to some light and dark grayish brown (10YR 4/3 and 4/2-5/3, and 5/2, some 6/2 and 3/2); some fine satiny to resinous black streaks. Moderately distinct streaked bedding and some laminae. Some fractured core and rubble. A 1-inch partly collapsed vug with fine boxworks and pyrite crystals at 1,050.2 feet.
1,050.7	1,053.3	Oil shale: Medium brownish and grayish brown (10YR 4/2-5/2 and 4/3-5/3); a 1/2-inch very dark satiny to resinous layer at 1,051.8. Faint to moderately distinct laminae; common fine loop structures. Some very short tight vertical fractures in lighter layers in lower part.
1,053.3	1,054.3	Oil shale: Grayish brown to black (10YR 4/3 and 4/2-1/2), common satiny to resinous luster. Faint to moderately distinct laminae and streaked bedding. Some broken core with shaly to papery parting.
1,054.3	1,056.0	Oil shale: Medium to dark grayish brown (10YR 4/3 and 4/2-3/2, some 2/2). Moderately distinct to faint laminae; some very fine loop structures. Some irregular vertical fractures with sparse to abundant pyrite.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,056.0	1,059.0	Marlstone: Buff to light and rare medium to dark brownish gray (10YR 8/2-6/2, some 5/2-3/2 in upper part becoming rare in lower part). Distinct laminae in upper part becoming faint in lower part; common very fine loop structures. Some high to low angle fractures with very fine pyrite. A small very fine-grained gray pyritic bleb at 1,056.6. A 1/2-inch massive tight gray mudstone band at 1,056.9. [Sample of buff marlstone from 1,058.7 feet: X-ray - dolomite, analcite, feldspar, ferroan, quartz.
1,059.0	1,061.7	Marlstone: Buff to very rare medium brownish gray (10YR 8/2-7/2, rare 6/2-5/2). Faint to some moderately distinct laminae; common fine loop structures and displacements. Common irregular tight fractures--frequently with abundant pyrite. Broken core and rubble in lower part.
1,061.7	1,063.0	Oil shale and marlstone: Medium to light brownish-gray oil shale (2.5Y 5/2-6/2) and tan to buff marlstone (10YR 6/3-8/2). Faintly laminated and streaked oil shale at 1,061.8-1,061.9 and 1,062.4-1,062.9; distinctly laminated marlstone in other parts. Common high angle fractures with pyrite. Some very fine gray streaks in oil shale.
1,063.0	1,064.4	Marlstone: Buff to some medium brownish gray (10YR 7/2-8/2, some 6/3-5/2). Faint to some distinct laminae. Common fractures with pyrite. Some irregular core pieces and rubble.
1,064.4	1,065.6	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-2/2, some 5/2); some very fine satiny to resinous streaks. Faint to moderately distinct streaked bedding. Some fine light brownish-gray earthy porous streaks and irregular cavities. Some high to very low angle fractures with abundant pyrite. Some broken core in lower part. [Sample of dark oil shale with some fine cavities from 1,065.1 feet: X-ray - dolomite, quartz, feldspar, analcite, ferroan.
1,065.6	1,066.6	Oil shale: Dark and rare medium brownish gray (10YR 3/2, some 2/2, rare 4/2-4/3); rare very fine satiny to resinous streaks. Faint streaked bedding.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,066.6	1,069.0	Oil shale: Dark to medium and rare light brownish gray (10YR 3/2-5/2, some 2/2 upper part, rare 6/2-6/3 lower part). Moderately distinct streaked bedding in upper 0.4 foot; faint to distinct laminae with common fine loop structures in lower part. Common short tight high angle fractures with some pyrite. Rare fine brownish-gray to gray silty streaks.
1,069.0	1,070.6	Oil shale: Grayish brown to buff (10YR and 2.5Y 5/3-7/2, some 8/2). Faint to distinct, regular to distorted and displaced laminae. Common tight irregular discontinuous fractures with pyrite. Some broken core and rubble.
1,070.6	1,072.3	Oil shale: Medium to some dark grayish brown (10YR 4/3 and 4/2-5/3 and 5/2, some 3/2). Faint fairly regular to distorted streaked bedding. Some irregular fractures with fine slickensides and pyrite. Some fine to small partly collapsed cavities; a 1- x 1-1/2-inch vug with coarse broken boxworks at 1,072.1. Some fine buff earthy porous streaks in middle part. Rounded core end at base.
1,072.3	1,073.2	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2, some 3/2), common satiny to resinous luster. Faint very fine regular laminae and streaked bedding. Regular thick to medium parting; very fine mineral crusts and disseminated pyrite on some parting surfaces. Some short tight diagonal fractures with very fine pyrite from 1,072.7 to 1,073.0. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of oil shale with very fine mineral crust on parting surface from 1,072.7 feet: X-ray - dolomite, feldspar, quartz, analcite, ferroan, illite, pyrite.</div>
1,073.2	1,073.5	Tuff (mudstone): Brownish gray to gray buff (10YR 4/2-7/1). Massive with a 1/2-to 1-inch stringer of dark to medium brownish-gray finely laminated oil shale in middle. Uneven sample split. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of tuff from 1,073.3 feet: X-ray - analcite, quartz, feldspar, ferroan, pyrite.</div>
1,073.5	1,074.7	Oil shale: Dark to some medium brownish gray and black (10YR 3/2-2/2, some 4/2 and 1/2), some satiny to resinous

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		luster. Faintly laminated; common fine loop structures in lower part. A very irregular thin gray-buff silty tuff stringer at 1,074.0 and a very thin tan to buff earthy tuff stringer at 1,074.5. A smooth nearly vertical fracture with slight olive-gray coatings and some very fine pyrite extends through interval.
1,074.7	1,077.4	Oil shale: Medium and rare dark grayish brown to tan and buff (10YR 4/3 and 4/2-6/3 and 7/2, rare 3/2-2/2); rare very fine satiny to resinous black streaks near top. Moderately distinct streaked bedding near top; faint to distinct laminae in other parts becoming distorted and displaced in lower foot. Common vertical to irregular fractures with slight earthy coatings and sparse very fine pyrite. Rare fine cavities. Common irregular core pieces and some rubble; uneven sample split.
1,077.4	1,078.6	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2, rare 5/2); some very fine satiny to resinous streaks. Faint distorted to regular streaked bedding. Some irregular high to low angle fractures with sparse very fine pyrite. Some broken core and rubble; uneven sample split.
1,078.6	1,079.6	Missing.
1,079.6	1,082.7	Oil shale: Dark brownish gray to rare black (10YR 3/2-2/2, rare 1/2); some satiny to rare resinous luster. Faint distorted to regular streaked bedding; becoming regularly laminated in lower 0.2 foot.
1,082.7	1,083.8	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2 upper part, rare 5/2 lower part). Faint laminae and some very faintly streaked zones. Some very fine pyritic blebs and streaks. Some irregular core pieces.
1,083.8	1,085.7	Oil shale: Grayish brown to some tan and rare buff (10YR 4/3-5/3, some 6/3, rare 7/2). Faint to moderately distinct very fine laminae. Abundant fine flat

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		cavities--commonly partly to completely filled with white calcite. Vertical muddy fracture surfaces throughout. Fine porous earthy collapse breccia with very fine pyrite in lower 0.3 foot. Uneven sample split.
1,085.7	1,087.2	Oil shale: Brownish gray (10YR to 2.5Y 4/2, rare 5/2-5/3). Faint streaked bedding. Irregular to "curly" core pieces and rubble. Common very fine pyrite. Length uncertain; partly grab sampled.
1,087.2	1,088.5	Oil shale: Brownish gray (10YR to 2.5Y 4/2). Faint very fine laminae; contorted and displaced in upper 0.3 foot. Common very fine dark gray pyritic blebs and streaks.
1,088.5	1,090.0	Oil shale: Grayish brown to buff (10YR 5/3-7/2, rare 5/2-4/2). Faint to some moderately distinct laminae. Common very fine buff earthy porous pyritic blebs. Mostly irregular fractured core pieces and rubble.
1,090.0	1,091.0	Oil shale: Brownish gray (2.5Y 4/2). Faint very fine laminae. Common very fine dark gray pyritic blebs and streaks. Some high angle fractures with very fine pyrite in lower part. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of oil shale with very fine pyritic blebs and streaks from 1,090.4 feet: X-ray - feldspar, dolomite, illite, quartz, ferroan, pyrite.</div>
1,091.0	1,092.0	Oil shale: Medium to dark brownish gray (2.5Y and 10YR 4/2-5/2, some 3/2-2/2 lower part). Faint to moderately distinct laminae. Common irregular tight to slightly open high angle fractures with pyrite and some <u>very porous earthy</u> to very fine granular fillings; very coarse pyrite on fracture near top. Some broken core.
1,092.0	1,093.6	Marlstone: Gray buff to light and rare medium slightly brownish and olive gray (2.5Y and 5Y 8/1-6/1, rare 5/1). Faintly laminated to very faintly streaked. Rubble and irregular fractured core pieces. Some fine slightly open breccia in lower part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,039.6	1,094.1	Oil shale: Dark brownish gray (2.5Y to 10YR 3/2-2/2). Faint streaked bedding. Common very fine pyritic specks and rare small blebs.
1,094.1	1,098.0	Missing?
1,098.0	1,098.8	Oil shale: As above. Some very fine satiny to resinous black streaks. Discontinuous core pieces with worn ends. A very irregular hackly muddy fracture in lower 0.2 foot.
1,098.8	1,100.0	Oil shale: Brownish gray (10YR 4/2-5/2). Faint very fine laminae. Very abundant very fine disseminated crystals (reflections from rough crystal faces give them a submetallic silvery appearance). Thin brown streaks with massive pyrite patches at 1,099.3. [Sample of oil shale with very abundant very fine "silvery" crystals from 1,099.9 feet: X-ray - Na feldspar, dolomite, analcite, illite, ferroan.
1,100.0	1,107.0	Oil shale: Medium to some dark brownish gray and grayish brown (10YR 4/2-5/2 and 4/3-5/3, some 3/2). Faint to moderately distinct laminae. Common discontinuous high angle fractures with brownish-gray to tan muddy coatings; some short irregular calcite-filled fractures with pyrite. Rare fine open and calcite-filled cavities in upper part. Common fine dense dark brownish-gray blebs in lower part. Some broken core.
1,107.0	1,109.0	Oil shale: Medium and some dark brownish gray (10YR and 2.5Y 4/2-5/2, some 3/2 upper part). Faint laminae and streaked bedding. Very abundant fine cavities partly to completely filled with white calcite. Some vertical to very irregular fractures with muddy coatings.
1,109.0	1,110.5	Oil shale: Light to dark brownish gray (10YR and 2.5Y 6/2-3/2); some satiny to resinous luster in lower part. Faint to moderately distinct laminae and streaked bedding. Common fine calcite-filled cavities in some zones. Some very irregular muddy fracture surfaces. Uneven sample split.
1,110.5	1,114.3	Oil shale: Medium to some dark brownish gray (10YR and 2.5Y 5/2-4/2, some 3/2). Faint streaked bedding and very fine laminae; some distorted bedding in upper part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Common irregular fractures--rarely with pyrite. Some small partly collapsed vugs and fine calcite-filled cavities in upper half-foot. Broken core and rubble in lower part.
1,114.3	1,115.0	Oil shale: Medium to rare dark brownish gray (10YR 5/2-4/2, rare 3/2-2/2). Faint streaked bedding to moderately distinct very fine laminae. Abundant very fine dark submetallic blebs in upper part. Abundant very fine flat buff to white specks in lower part.
1,115.0	1,116.5	Oil shale: Medium and rare light brownish gray to some black (10YR and 2.5Y 5/2-2/2, some 1/2, rare 6/2), some satiny to resinous luster. Fairly distinct to faint laminae. Very abundant fine cavities with buff to white calcite fillings. Some irregular high angle muddy fracture surfaces in lower part. Sample of dark oil shale with abundant fine calcite cavity fillings from 1,115.4 feet: X-ray - feldspar, dolomite, quartz, calcite, illite, pyrite.
1,116.5	1,117.0	Oil shale: Brownish gray to black (2.5Y 4/2-1/2). Common satiny to resinous luster. Faint to moderately distinct laminae; some fine to 1/2-inch loop structures. Common fine flat calcite cavity fillings at 1,116.7-1,116.9. Sample of dark oil shale from 1,116.6 feet: X-ray - Na feldspar, dolomite, quartz, illite.
1,117.0	1,118.6	Oil shale: Medium to dark brownish gray (10YR to 2.5Y 4/2-3/2, some 2/2 near base, rare 5/2); some satiny to resinous luster near base. Faint very fine laminae and streaked bedding. Abundant very fine dark gray pyritic (?) flecks. Common tight medium to high angle fractures in upper part; common fine streaks and discontinuous medium to high angle fractures with buff-white chalky to silty calcite and some fine pyrite from 1,117.6 to 1,118.4. Very abundant very fine cavities with calcite in lower 0.2 foot.
1,118.6	1,118.8	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2). Faint distorted and displaced laminae. Common very

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Irregular fine to 1/2-inch fractures with silty tan calcareous fillings and some pyrite.
1,118.8	1,123.0	Claystone and mudstone (oil shale in part): Gray buff to some medium brownish gray and olive gray (2.5 to 5Y 8/1-6/1, some 5/1-5/2). Mostly fractured core and rubble with fairly abundant very fine pyrite some tight to slightly open and crumbly claystone breccia. Some pieces of faintly laminated to streaked oil shale with abundant fine pyritic calcite blebs and streaks. Mostly grab sampled. Sample of gray-buff crumbly claystone breccia from 1,121.0-1,123.0 feet: X-ray - dolomite, feldspar, quartz, calcite, illite, pyrite.
1,123.0	1,126.0	Oil shale: Light to some dark brownish gray (2.5Y to 10YR 6/2-4/2, some 3/2). Faint streaked bedding. Common irregular discontinuous tight to very open fractures and fine to small partly collapsed cavities frequently with earthy to very fine granular calcite and pyrite. Broken core and rubble in lower part. Very uneven sample split.
1,126.0	1,128.1	Oil shale: Medium and some dark grayish brown (10YR 4/3 and 4/2-5/3 and 5/2, some 5/4 and 3/2 in upper part). Faint to moderately distinct laminae and some streaked bedding. Common fine to 1/2-inch partly collapsed cavities with buff and tan to gray, earthy to silty fillings. Common very fine dark gray specks and streaks in some parts.
1,128.1	1,130.3	Oil shale: Medium to some dark and rare light brownish gray (2.5Y 4/2, some 3/2, 10YR 4/2-6/2 in lower 0.4 foot). Faint laminae and streaked bedding. Very abundant very fine cavities with buff to white fillings. Some irregular fractured core pieces in upper part.
1,130.3	1,131.5	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, rare 5/2 upper part). Faint streaked bedding. Common small to fine cavities with porous earthy buff fillings. Common very fine dark gray specks and streaks. Some high angle fractures in upper part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,131.5	1,132.7	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-4/2, some 5/2-5/3 near base). Nearly massive in upper part to faint very fine laminae in lower part. Common very fine dark gray specks and streaks. Common very fine tan earthy specks in lower part. Uneven sample split.
1,132.7	1,135.7	Oil shale: Brownish gray to buff (2.5Y 4/2-7/2). Faint laminae and streaked bedding. Common small to fine partly collapsed cavities with buff granular to earthy fillings and pyrite. Common irregular high angle fractures; some broken core and rubble.
1,135.7	1,136.9	Oil shale: Medium to dark brownish gray (2.5Y to 10YR 5/2-3/2, rare 2/2). Faint very fine laminae and streaked bedding. Common fine buff earthy blebs and streaks. Common very fine pyrite blebs in upper part. A thin tan silty layer at 1,136.2.
1,136.9	1,138.3	Oil shale: Medium to light brownish gray (2.5Y 5/2-6/2). Faint very fine laminae and streaked bedding. Common small to fine partly collapsed cavities with tan to yellowish-buff granular porous fillings and abundant pyrite. A thin light gray silty claystone layer at 1,137.2. Irregular fractured core pieces in lower part; uneven sample split.
1,138.3	1,140.0	Mudstone: Buff (2.5Y 8/2-7/2). Fractured to crumbly earthy chunks and rubble. Grab sampled.
1,140.0	1,158.0	Missing.
1,158.0	1,162.1	Oil shale: Medium to some dark brownish gray and rare tan to buff (2.5Y and 10YR 5/2 and 5/3-4/2 and 4/3, some 3/2, rare 6/3-7/2). Faint to rare distinct laminae; some gray laminae near top. Common very fine dark flecks and streaks in some parts. Some irregular fractured core pieces and rubble. Length and continuity doubtful.
1,162.1	1,164.0	Marlstone and mudstone: Buff to rare tan and grayish brown (2.5Y 8/2-7/2, rare 6/3-4/3). Faintly laminated.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Very common tight to open fractures and some large to small coarse to fine breccia masses in upper half; rubble in lower half. Abundant very fine pyrite.
1,164.0	1,165.2	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 5/2-3/2). Faint very fine laminae and streaked bedding. Common very fine gray pyritic (?) specks and streaks. Few fine tan earthy to silty laminae with some gray blebs. Some small irregular core pieces and rubble.
1,165.2	1,176.0	Missing.
1,176.0	1,176.6	Oil shale: Medium and some dark olive gray in upper part (5Y 4/2-3/2) to medium and some light brownish gray in lower part (2.5Y 4/2-5/2, some 10YR 6/2). Faintly streaked in upper part to distinctly laminated in lower part. Some fine dark gray slightly silty laminae. Some tight medium to high angle fractures in lower part. A fine vitreous black organic lens near base.
1,176.6	1,178.1	Marlstone and mudstone: Buff to gray buff and some tan to brownish gray (2.5Y and 10YR 7/2-8/2 and 8/1, some 6/3-5/2, rare 4/2). Distinct to faint laminae. Some regular thin shaly parting. Some fine gray laminae. Abundant very fine dark gray specks and streaks in upper part. Few high angle fractures. [Sample of buff to gray-buff mudstone from 1,177.4 feet: X-ray - dolomite, feldspar, quartz, ferroan.
1,178.1	1,179.1	Oil shale: Medium and some light brownish gray (10YR and 2.5Y 5/2-4/2, some 6/2). Faint to moderately distinct very fine laminae. Rare medium to dark gray laminae. Abundant very fine dark gray flecks in upper part.
1,179.1	1,180.3	Oil shale: Brownish gray (10YR 5/2-4/2, rare 4/1). Faint very fine laminae. Some high angle fractures with slight earthy coatings.
1,180.3	1,181.5	Oil shale: Medium to some dark brownish gray (2.5Y 4/2-5/2, some 3/2), grayish brown in lower 0.1 foot (10YR

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		4/2 and 4/3-5/2 and 5/3). Faint very fine laminae. Rare very fine buff earthy streaks. Rare tight medium to high angle fractures.
1,181.5	1,182.8	Oil shale: Dark to medium brownish gray (2.5Y and 10YR 3/2-4/2 and 4/3, rare 2/2); rare satiny to resinous streaks and laminae. Faint to moderately distinct streaked bedding and some laminae. Rare fine brown to tan streaks and laminae. Some irregular fractured core pieces in lower part.
1,182.8	1,184.5	Mudstone: Light brownish gray to buff and gray buff (2.5Y 6/2 and 6/1-8/2 and 8/1). Faint slightly irregular laminae. Irregular broken core pieces and rubble.
1,184.5	1,186.5	Mudstone and siltstone: Light slightly olive gray to gray buff (5Y 6/1-8/1). Faint fairly regular laminae to thick massive bands. Some broken core and rubble. Sample of massive gray-buff siltstone from 1,186.3 feet: X-ray - dolomite, quartz, feldspar, pyrite, ferroan.
1,186.5	1,189.0	Missing. Core sequence doubtful from 1,189.0 to 1,203.0 feet.
1,189.0	1,190.0	Oil shale: Dark to some medium brownish gray (10YR and 2.5Y 3/2-2/2, some 4/2), rare satiny luster. Faint streaked bedding and some laminae. Rare very fine brown to tan streaks and lenses. A 1-inch piece of porous papery leached oil shale at base.
1,190.0	1,198.9	Mudstone and some siltstone: Light slightly olive and brownish gray to gray-buff (5Y to 2.5Y 6/1-7/1). Faintly laminated and streaked to massive. Mostly irregular broken core pieces and rubble. Rare small pieces of dark to medium brownish-gray oil shale. (At least 5.1 feet missing.)
1,198.9	1,203.0	Missing.
1,203.0	1,204.0	Oil shale (rubble): Dark brownish gray. Few large pieces of porous leached oil shale with irregular streaks and patches of papery breccia.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,204.0	1,205.0	Oil shale: Brownish gray (2.5Y 4/2-5/2); a 1-inch very dark satiny to resinous band near top and some very fine dark laminae in lower 3 inches. Very faint to distinct laminae. Irregular vuggy parting surface at top.
1,205.0	1,206.4	Mudstone: Light to rare medium brownish gray (2.5Y 6/1-6/2, rare 5/2). Faint to some moderately distinct laminae and thin bands. A high angle fracture with muddy coatings from top to bottom.
1,206.4	1,207.5	Oil shale: Dark to some medium brownish gray (10YR 3/2-2/2, some 4/2). Faintly streaked in upper part to very finely laminated in lower part. Some irregular fractured vuggy core pieces in upper part.
1,207.5	1,208.7	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2, some 5/2). Faint to fairly distinct laminae; common fine displacements in lower part. Common <u>very</u> fine light specks in lighter zones. A 0.1-foot brownish-gray silty tuff with black tarry stains at top; a fine tuff stringer at 1,207.9. Vertical fracture with chalky white coatings in lower half foot. <div style="margin-left: 40px;">Sample of tuff from 1,207.5 feet: X-ray - Na and K feldspars, quartz, pyrite.</div> <div style="margin-left: 40px;">Sample of brownish-gray oil shale with very fine light specks from 1,208.3 feet: X-ray - quartz, dolomite, feldspar, ferroan, pyrite, illite.</div>
1,208.7	1,210.0	Oil shale: Medium and some dark brownish gray (10YR 4/2, some 3/2); rare very fine resinous black streaks near base. Faint streaked bedding.
1,210.0	1,212.5	Mudstone: Light to medium slightly brownish gray (10YR 6/1-5/1). Faint slightly irregular laminae and bands to thick massive zones. Hard and tight. Vertical fracture with chalky coatings below 1,211.4.
1,212.5	1,214.6	Oil shale: Medium to some dark brownish gray (10YR 4/2-5/2, some 3/2 lower part). Faint streaked bedding to massive. Hard and tight. Some high angle fractures with chalky patches in upper part. Two very small light gray silty blebs at 1,214.2.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,214.6	1,215.6	Oil shale: Dark brownish gray (10YR 3/2-2/2). Faint very fine streaked bedding. Some fine dark brownish-gray very fine crystalline streaks at 1,215.3.
1,215.6	1,216.6	Oil shale: Dark to medium grayish brown (10YR 2/2-4/2 and 4/3). Faint streaked bedding and very fine laminae. Some fine to thin displaced buff to brown dolomite (?) layers. Sample of thin brown layer from 1,216.5 feet: X-ray - dolomite; trace quartz, feldspar.
1,216.6	1,220.0	Midstone: Buff to tan and rare medium brownish gray (10YR 7/2-6/3 and 6/2, some 8/2, rare 5/2-3/2). Faint to rare distinct streaked bedding and slightly irregular laminae and bands. Some high angle fractures with medium to dark brown coatings and rare fine chalky spots. Some irregular tight fractures and small to fine partly collapsed cavities at 1,218.8-1,219.0.
1,220.0	1,221.0	Oil shale: Medium and some light grayish brown (10YR 5/2 and 5/3-4/2 and 4/3, some 6/2 upper part). Moderately distinct to very faint very fine laminae and streaked bedding. A 1/2-inch dense brown dolomite band with tight vertical fractures at 1,220.2; some small to 1-inch dolomite nodules in lower 0.2 foot.
1,221.0	1,223.0	Oil shale: Brownish gray (10YR 4/2, some 4/3 in upper part). Faint streaked bedding. Some small to 1- x 1-1/2- x 3- inch dense brown to dark brownish-gray dolomite nodules. [Sample of dark brownish-gray dolomite nodule from 1,222.6 feet: X-ray - dolomite; trace quartz, analcite, feldspar.
1,223.0	1,225.5	Oil shale: Medium to some dark grayish brown (10YR 4/2-4/3, some 3/2). Faint streaked bedding. Fairly common small to large dolomite nodules; one huge nodule (2-1/4 by at least 5 inches) at 1,224.3 has fine distinct internal laminae inclined about 20° to bedding of inclosing oil shale; some small dolomite masses appear to be angular fragments. A thin tan to buff slightly earthy tuff (?) stringer near base.
1,225.5	1,226.5	Oil shale: Dark and some medium brownish gray (10YR 3/2-2/2, some 4/2-4/3). Faint very fine laminae and

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		streaked bedding. Irregular thin buff to brownish-gray tuff stringers at 1,225.7 and 1,226.1; a very thin regular gray to gray-buff tuff layer at 1,225.9. A thin streak of resinous black gar (?) fragments at 1,225.6.
1,226.5	1,227.5	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2 and 4/3, some 2/2). Faint streaked bedding. Very rare fine resinous black fossil fragments.
1,227.5	1,228.1	Oil shale: Brownish gray (10YR 4/2-4/3). Faintly streaked to massive.
1,228.1	1,229.2	Oil shale: Light to medium brownish gray and some buff (10YR 6/2 and 6/3-5/2 and 5/3, some 7/2). Faint to moderately distinct streaked bedding. Rare fine dark gray silty streaks. Fine mudcrack (?) fillings of oil shale as above near top.
1,229.2	1,230.0	Oil shale: Medium and some light to rare dark grayish brown (10YR 5/3-4/3, some 6/2, rare 3/2). Faint streaked bedding and very fine laminae. Some short tight fractures with varnish-like patches near top.
1,230.0	1,232.9	Oil shale: Grayish brown to tan and buff (10YR 5/3-7/2, some 5/4-6/4 upper part). Moderately distinct laminae and streaked bedding. High angle fractures with slight muddy coatings throughout; broken core in lower 0.2 foot. Rare fine black pyritic blebs in lower part.
1,232.9	1,234.9	Oil shale: Grayish brown (10YR 5/3-4/3). Faint to moderately distinct streaked bedding. Common fine to small cavities with tan to white earthy to drusy linings and some with bitumen fillings down to 1,234.1; few black pyritic streaks and white blebs in lower part. Rare small dense massive grayish-brown dolomite nodules. <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 10px; margin-left: 40px;"> Sample of oil shale with small drusy cavities from 1,233.9 feet: X-ray - quartz, dolomite, feldspar, dawsonite. </div>
1,234.9	1,236.9	Oil shale: Medium and rare dark grayish brown (10YR 4/3-4/2, some 5/3-5/2, rare 3/2). Massive to faintly streaked. Brownish-gray to dark gray, fairly dense to silty tuff in lower 0.3 foot; some short tight high angle fractures.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,236.9	1,237.9	Oil shale: Medium and rare dark grayish brown (10YR 4/3 and 4/2-5/3, rare 3/2). Faint streaked bedding and some very fine discontinuous laminae. Rare small dense dolomite nodules.
1,237.9	1,238.8	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-2/2), rare satiny to resinous luster. Faint streaked bedding and some very fine laminae. Rare short tight high angle fractures.
1,238.8	1,239.4	Oil shale: Grayish brown (10YR 4/3-4/2). Very faintly bedded. Rare fine dense brown dolomite streaks.
1,239.4	1,240.6	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-2/2). Faint streaked bedding and very fine laminae. Some fine to thin, dense to silty-crystalline, grayish-brown to buff streaks and lenses. [Sample of oil shale with fine dense to silty-crystalline streaks from 1,240.2 feet: X-ray - ferroan, quartz, dolomite, feldspar.
1,240.6	1,241.5	Oil shale: Brownish gray (10YR 4/2-4/3). Very faint streaked bedding. Some fine dark gray pyritic streaks and stringers in lower part.
1,241.5	1,243.1	Oil shale: Medium to very dark brownish gray (10YR 4/2 and 4/3-2/2, some 5/2-5/3). Moderately distinct to very faint laminae and streaked bedding. Rare fine brownish-gray to buff, silty to slightly earthy streaks and layers.
1,243.1	1,244.4	Missing? Some irregular rounded pieces (caving fragments?) of tan marlstone and light slightly olive gray mudstone.
1,244.4	1,247.5	Oil shale: Dark to rare medium brownish gray (10YR to 2.5Y 2/2-3/2, rare 4/2 lower part), common satiny to resinous luster. Faint streaked bedding; rare fine distinct tan laminae and streaks in upper part. Rare fine dark gray silty pyritic streaks. A fine waxy black organic streak at 1,246.6.
1,247.5	1,247.7	Tuff: Light brownish gray to buff (2.5Y 6/2 and 6/1-7/2), tight, silty textured. Massive with very fine

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		grayish-brown mottling and some fine gray stringers. Some irregular tight high angle fractures with dark grayish-brown mottling. [Sample of tuff from 1,247.6 feet: X-ray - Na feldspar, quartz.
1,247.7	1,248.8	Oil shale: Medium to dark and some light grayish brown (10YR 5/3 and 5/2-3/2, some 6/2 upper part). Moderately distinct laminae with common fine displacements in upper part to very faint streaked bedding in lower part. Rare very fine waxy black organic streaks.
1,248.8	1,250.6	Oil shale: Medium to dark brownish gray (10YR 4/3 and 3/2 upper part to 3/2 and 2/2 lower part). Faint streaked bedding; some very fine displaced laminae near top. Rare fine dense brown dolomite lenses and small dense gray nodules. Rare very fine waxy black organic streaks in lower part. [Sample of small dense gray nodule with some oil shale from 1,249.4 feet: X-ray - ferroan, feldspar, pyrite, analcite, dolomite, quartz.
1,250.6	1,251.0	Oil shale: Dark brownish gray and medium brown (10YR 3/2-2/2 and 4/3-4/4). Faint to distinct laminae and streaks.
1,251.0	1,252.8	Oil shale: Dark and rare medium brownish gray (10YR 3/2-2/2, rare 4/2-4/3). Faint very fine laminae and streaked bedding; distorted and displaced in lower half foot. A thin gray silty layer at 1,251.6.
1,252.8	1,253.8	Oil shale: Like 1,250.6-1,251.0 feet.
1,253.8	1,254.4	Oil shale: Like 1,251.0-1,252.8 feet. A thin pinched out gray silty layer at 1,253.9. [Sample of gray silty layer from 1,253.9 feet: X-ray - pyrite, marcasite, dolomite, feldspar, analcite, dawsonite, quartz.
1,254.4	1,255.3	Oil shale: Dark to medium brownish gray (10YR 3/2-5/2, some 4/3). Faint very fine laminae and streaked bedding. Very fine striated brittle vitreous black organic crusts on parting surfaces at 1,254.7. Some high angle fractures with very fine chalky specks in lower part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,255.3	1,260.0	Mudstone: Buff and gray buff (10YR to 2.5Y 8/2-7/2 and 7/1). Faint irregular laminae and streaks to thick massive bands. Some light to medium gray silty streaks and laminae. High angle fracture with varnish-like to earthy coatings and some chalky patches from top to 1,257.0; diagonal fracture with vitreous black bitumen patches from 1,259.0 to 1,259.5.
1,260.0	1,261.0	Mudstone and marlstone: Buff to light brownish gray (10YR and 2.5Y 7/2-6/2 and 6/1). Moderately distinct laminae to faint streaked bedding. Rare fine medium to dark gray streaks. Rare fine white crystalline lenses with very fine black flecks in upper part. Irregular high angle fracture with very fine patchy vitreous black crusts from 1,260.3 to base.
1,261.0	1,261.6	Oil shale: Light brownish gray to medium grayish brown (10YR 6/2 and 6/1-5/2 upper part, 4/3 lower 0.2 foot). Faint streaked bedding and some moderately distinct laminae in upper part; very faint bedding in lower 0.2 foot.
1,261.6	1,263.6	Oil shale: Light to medium brownish gray (10YR and 2.5Y 6/2-5/2, some 6/1-5/1 upper part). Faint very fine laminae and some very faintly streaked to massive bands. Some very fine gray laminae in upper part. Vertical fracture with brown earthy coatings and some bitumen crusts and dull white mineral patches from top to 1,262.6. Rare very fine medium to dark brownish-gray crystalline streaks in lower part.
1,263.6	1,265.6	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 5/2 and rare 2/2 in lower part). Faint laminae and streaked bedding.
1,265.6	1,267.7	Oil shale: Dark to light brownish gray (10YR 2/2-6/2); common very fine satiny to resinous black streaks in dark zones. Faint streaked bedding in thick to thin darker and lighter zones; some faint very fine laminae in lighter zones. A 1-inch grayish-brown slightly silty tuff stringer at 1,265.7; some fine vermiform

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Laramie Energy Research Center, Laramie, Wyoming

May 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		grayish-brown stringers in oil shale below. Rare short tight high angle fractures in lighter zones. [Sample of grayish-brown tuff from 1,265.7 feet: X-ray - K feldspar, ferroan, marcasite?]
1,267.7	1,270.2	Oil shale: Dark brownish gray (10YR 3/2-2/2); common fine satiny to waxy black streaks. Faint streaked bedding. Occasional fine to small dense grayish-brown dolomite streaks and blebs. A thin vermiform grayish-brown to tan stringer from 1,268.9 to 1,269.3.
1,270.2	1,272.2	Oil shale to slightly silty marlstone: Medium and some dark brownish gray in upper part to tan and buff in lower part (10YR 4/2 and some 3/2 to 6/3 and 7/2). Faint streaked bedding in upper part to faint laminae and thin bands in lower part. Rare very fine dark gray pyritic streaks. Vertical fracture with chalky calcite crusts and earthy brown coatings extends from 1,271.6 into interval below.
1,272.2	1,275.3	Marlstone and mudstone: Light brownish gray to buff (10YR to 2.5Y 6/2-7/2). Massive to faintly streaked and laminated. Vertical fracture with earthy coatings continues from above to 1,274.0; some broken core. Thin brown slightly silty layer at 1,274.3; very thin displaced brownish-gray silty layer and some fine streaks with abundant fine dark pyritic blebs at 1,274.9. Few small brownish-gray crystalline masses with chalky white centers and very fine dark specks around rims at 1,274.5 and one very small triangular mass with very pyritic rims near base. [Sample of buff mudstone with small crystalline masses from 1,274.5 feet: X-ray - quartz, dawsonite, dolomite, feldspar, ferroan, pyrite.]
1,275.3	1,276.4	Marlstone and oil shale: Buff and gray buff to light and rare medium brownish gray (10YR 7/2 and 7/1-6/2, rare 5/2-4/2). Faint to moderately distinct very fine laminae; some very fine loop structures. Broken core in upper half. Some fine to thin zones with abundant very fine black pyritic specks in lower part.
1,276.4	1,277.7	Oil shale: Grayish brown (10YR 4/3-5/3). Very faint streaked bedding. Some <u>1-inch vugs with porous</u>

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		fillings and abundant milky white quartz grains and blebby black rims at 1,276.8; some fine to rare small cavities in lower part. A thin dense grayish-brown dolomite lens at 1,277.5.
1,277.7	1,279.0	Oil shale: Light to some dark brownish gray and rare buff (10YR and 2.5Y 6/2-4/2, some 3/2 lower part, rare 7/2 upper part). Fairly distinct to faint very fine laminae; rare fine displacements. A 1-1/2- x 2-1/2-inch vug with fine radiating boxworks, drusy quartz, and black pyritic rims near top. A thin brown dolomite layer at 1,278.1. A 3/4-inch light brownish-gray silty tuff band at 1,278.8. Few short tight vertical fractures. Sample of vug filling from 1,277.8 feet: X-ray - quartz, some pyrite.
1,279.0	1,280.4	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2 and 4/3, some 2/2 upper part). Faint very fine laminae to very faint streaked bedding. Rare fine grayish-brown to tan slightly blebby dolomite (?) layers.
1,280.4	1,282.4	Marlstone: Buff to tan and rare grayish brown (10YR 7/2-6/3, some 8/2, rare 5/3 upper part). Faint to moderately distinct slightly irregular laminae and some very faintly streaked bands.
1,282.4	1,285.5	Marlstone and mudstone: Buff to some light brownish gray and tan (10YR 7/2-8/2, some 6/2-6/3). Faintly streaked to laminated and banded; common fine loop structures and displacements in laminated zone at 1,284.5-1,285.0. Some distorted bedding in upper part.
1,285.5	1,287.5	Marlstone and some mudstone: Buff to tan and very rare grayish brown (10YR 8/2-6/3, rare 5/3-4/3). Faint to rare distinct very fine laminae with some very fine loop structures and displacements; very faintly streaked to massive zones at 1,286.1-1,286.8 and 1,287.3-1,287.5. Few fine milky white and dull black blebs at 1,287.3.
1,287.5	1,288.0	Oil shale: Tan to grayish brown (10YR 6/3-4/3 and 4/2). Fairly distinct to faint very fine laminae. A thin

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		tan to brown, dense to slightly silty and blebby layer in middle.
1,288.0	1,289.5	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, rare 5/3). Faint streaked bedding. Abundant very fine cavities with dull black and milky white blebs near top. A fine waxy black fossil fragment at 1,289.0.
1,289.5	1,291.7	Oil shale: Medium to dark grayish brown (10YR 5/3-3/2). Fairly distinct streaked bedding and some shredded stringers. Some small to 1-inch brown dolomite nodules and lenses. Rare fine dull black blebs and blebby streaks in lower part. <div style="margin-left: 40px;"> { Sample of grayish-brown oil shale with fine blebby black streaks from 1,291.1 feet: X-ray - dolomite, quartz, dawsonite, feldspar, pyrite. </div>
1,291.7	1,292.4	Oil shale: Medium to dark grayish brown and rare tan (10YR 5/3-3/2, rare 6/3 and 2/2), rare satiny to resinous luster. Faint streaked bedding and laminae in distinct thin to 1-1/2-inch darker and lighter zones; rare fine loop structures and displacements.
1,292.4	1,294.4	Oil shale: Medium to light and very rare dark grayish brown (10YR 5/3-6/2, rare 4/3-2/2). Faint streaked bedding and very fine laminae. Some tight high angle fractures. Rare fine black smudgy streaks and short vertical fracture fillings. A very thin layer of dark oil shale with some satiny streaks near base.
1,294.4	1,295.8	Oil shale: Light to medium brownish gray (2.5Y 6/2-5/2). Faint laminae with common very fine loop structures in upper 3 inches; moderately distinct to very faint streaked bedding in other parts. Rare fine dark gray streaks and smudges. Very rare fine brown dolomite streaks.
1,295.8	1,296.9	Oil shale: Grayish brown and some brown (10YR 5/3-4/3, some 5/4). Faint laminae and thin bands; some fine displacements. Rare short tight vertical fractures. Thin gray silty layer at 1,296.1. <div style="margin-left: 40px;"> { Sample of thin gray silty layer from 1,296.1 feet: X-ray - Na feldspar, pyrite. </div>

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,296.9	1,298.1	Oil shale: Medium and rare dark grayish brown (10YR 4/3 and 4/2-5/3 and 5/2, rare 3/2 upper part). Faint streaked bedding to very fine laminae with some fine displacements. Rare very short tight vertical fractures. Some dark gray smudges at 1,297.8-1,297.9.
1,298.1	1,302.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2 and 4/3, rare 2/2 upper and lower parts). Very faint to moderately distinct streaked bedding. Very rare small to fine dark silty blebs.
1,302.0	1,303.4	Oil shale: Medium and rare dark grayish brown (10YR 4/3 and 4/2-5/3, rare 3/2). Faint streaked bedding to faint and some moderately distinct very fine laminae; common fine displacements in middle part. Rare very short tight vertical fractures. A fine pinched out dense buff layer with dark gray rims at 1,303.2.
1,303.4	1,307.5	Oil shale: Dark to rare medium brownish gray (10YR 2/2-3/2, rare 4/2-4/3 lower part); common very fine satiny to resinous black streaks. Faint streaked bedding. Rare very fine buff to brown crystalline streaks and blebs.
1,307.5	1,310.6	Oil shale: Medium to dark grayish brown (10YR 4/3 and 4/2-3/2, some 2/2), rare satiny streaks. Faint to moderately distinct streaked bedding. Dense brown dolomite (?) with very abundant very fine lacy black fractures and some very small porous blebs and streaks of pale brown to buff granular quartz (?) at 1,307.8-1,308.0; some fine to small dolomite lenses and blebs in other parts. <div style="margin-left: 40px;"> Sample of fractured dolomite (or oil shale?) from 1,307.9 feet: X-ray - quartz, dolomite, dawsonite, feldspar, ferroan, pyrite. </div>
1,310.6	1,311.1	Oil shale: Medium to dark grayish brown (10YR 4/3 and 4/2 in upper part to 3/2 lower part). Very faint streaked bedding and some very fine laminae. Some fine gray silty-crystalline streaks and lenses.
1,311.1	1,313.7	Oil shale: Very dark to rare medium brownish gray and some black (10YR 2/2-3/2, some 1/2 upper part,

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		rare 4/2 lower part); some thin resinous layers and streaks in upper part to rare very fine satiny streaks in lower part. Rare very fine crystalline streaks and blebs. Some thin dense brown dolomite lenses at 1,312.2-1,312.5.
1,313.7	1,314.5	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2), rare satiny to resinous luster. Faint streaked bedding to <u>very</u> fine laminae. A very thin dense grayish-brown dolomite layer near base.
1,314.5	1,315.1	Dolomite: Grayish brown to buff (10YR 5/3-8/2, some 4/3). Faint to fairly distinct, dense to very fine blebby-textured laminae. Some dark oil-shale laminae mostly in upper and lower parts. Sample of dense to blebby dolomite with rare very fine oil-shale laminae from 1,314.8 feet: X-ray - dolomite; trace quartz, feldspar.
1,315.1	1,316.1	Oil shale: Medium to dark and rare light brownish gray (10YR 5/2-3/2, rare 6/2 upper part). Fairly distinct to faint laminae; slightly distorted in upper part. A fine gray silty lamina at 1,315.8.
1,316.1	1,316.6	Oil shale: Grayish brown to black (10YR 4/3-1/2), some satiny to resinous luster. Faint to fairly distinct laminae; common fine to 1/4-inch loop structures.
1,316.6	1,317.4	Mudstone and marlstone: Light to rare medium brownish gray (2.5Y to 10YR 6/2, rare 5/2). Faint streaked bedding to some very fine laminae. Common fine light to medium gray silty streaks and layers.
1,317.4	1,318.0	Oil shale: Medium and rare dark brown (10YR 5/3-4/3 and 4/4, some 4/2 and rare 3/2 upper part). Faint very fine laminae. Common very fine dense gray-buff streaks in upper part.
1,318.0	1,318.5	Oil shale: Brown to black (10YR 4/4-1/2), rare satiny luster. Moderately distinct laminae; some fine to thin loop structures in upper part. Some slightly irregular thin to fine dense brown dolomite layers near base. Slightly unconformable contact at base (possibly displaced along a low angle fracture).

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,318.5	1,319.8	Oil shale: Buff to grayish brown (10 to 7.5 YR 7/2-5/2 and 5/3, rare 4/2-4/3 lower part). Moderately distinct to faint laminae becoming irregular and discontinuous in lower part. Massive buff marlstone with very tight high to low angle fractures in upper 0.2 foot. Some irregular displacements of up to 1/4-inch in lower part.
1,319.8	1,321.3	Mudstone and marlstone: Buff to light brownish gray (2.5Y and 10YR 7/2-6/2). Faint slightly distorted and displaced laminae and streaks. High angle fracture with slight tan to gray-buff earthy coatings from 1,320.6 to 1,321.0.
1,321.3	1,322.4	Marlstone and oil shale: Buff to medium and rare dark grayish brown (10YR 8/2-4/3, rare 3/2 lower part). Faintly laminated to streaked oil shale at 1,321.3-1,321.5 and 1,322.0-1,322.4; faintly streaked to massive buff marlstone in middle.
1,322.4	1,324.9	Marlstone and oil shale: Buff to some grayish brown (10YR 7/2 and 6/2 upper part to 6/2 and some 5/2-5/3 lower part). Thick to thin, faintly streaked to very finely laminated zones and nearly massive zones. Tight high angle fractures through most of interval.
1,324.9	1,326.0	Oil shale: Light to dark brownish gray (10YR 6/2 and 5/2 upper part to 3/2 and rare 2/2 lower part). Faintly laminated in upper part to massive and faintly streaked in lower part.
1,326.0	1,328.4	Oil shale: Very dark to rare medium brownish gray (10YR 2/2-3/2, 4/2-4/3 at 1,327.1-1,327.2); rare very fine satiny to resinous black streaks. Faint streaked bedding. Some very fine black pyritic streaks and blebs at 1,327.0 and 1,327.3; rare fine streaks and very small blebs in lower part.
1,328.4	1,329.6	Oil shale: Dark brownish gray to black and rare brown (10YR 3/2-1/2, rare 4/3-4/4), common satiny to resinous luster. Faint streaked bedding; faint to moderately distinct laminae with some loop structures at 1,328.8-1,329.1. Rare fine dark crystalline streaks and blebs near top. Sample of very dark oil shale with rare fine dark

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		crystalline streaks and blebs from 1,328.5 feet: X-ray - quartz, dolomite, dawsonite, feldspar, ferroan.
1,329.6	1,331.0	Oil shale: Medium and rare light brownish gray (10YR 4/2, some 5/2 and rare 6/2 upper part); some very fine dark satiny streaks in lower part. Faintly laminated near top to very faintly streaked. A thin dense grayish-brown dolomite streak near base.
1,331.0	1,331.5	Oil shale: Medium and some dark grayish brown (10YR 4/3, some 3/2, rare 2/2); some satiny streaks and rare resinous black laminae. Moderately distinct distorted streaked bedding; fairly distinct laminae with rare loop structures in lower inch. Few thin grayish-brown dolomite streaks in upper half.
1,331.5	1,332.1	Oil shale: Tan to buff and some grayish brown (10YR 6/3 and 6/1-7/2, some 5/3-4/3 upper part, rare 8/2). Distinct to faint laminae; rare very fine displacements. Some fine to thin dense gray silty streaks and layers in lower part.
1,332.1	1,332.6	Mudstone: Buff (10YR 7/2), massive.
1,332.6	1,335.1	Mudstone and marlstone: Buff to light and very rare medium brownish gray (10YR and 2.5Y 7/2-6/2, rare 5/2). Faint and rare moderately distinct, very fine to thin laminae. Some very fine dense gray silty streaks in upper part becoming rare in lower part.
1,335.1	1,336.0	Oil shale: Light brownish gray to buff (10YR and 2.5Y 6/2-7/2). Faint very fine laminae. Rare very fine dense gray silty streaks. Very rare very fine dark brownish-gray crystalline streaks. A 2- x 3-inch irregular rounded piece of light slightly olive gray mudstone at 1,335.7.
1,336.0	1,337.0	Oil shale: Light to medium brownish gray (10YR 6/2-4/2). Moderately distinct to faint laminae.
1,337.0	1,338.0	Oil shale: Medium to some dark brownish gray (10YR 4/2, rare 5/2 upper part, some 3/2 near base). Very faintly bedded with some very fine laminae.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Cont.)

From	To	Description
1,338.0	1,340.6	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-3/2); rare very fine satiny to resinous black streaks. Faint to moderately distinct streaked bedding; some distorted zones. Common very fine black pyritic streaks and blebs in some zones. A very irregular fine to 1-inch buff-white earthy and silty stringer at 1,340.2. Slightly irregular contact with very dark oil shale below with a thin grayish-brown slightly silty lens between. [Sample of buff-white stringer from 1,340.2 feet: X-ray - quartz, K and Na feldspars, ferroan.
1,340.6	1,341.2	Oil shale: Black to dark brownish gray (10YR 1/2-3/2), common satiny to resinous luster. Faint streaked bedding. Rare small dense grayish-brown dolomite blebs near base.
1,341.2	1,346.2	Marlstone and mudstone: Buff to light and rare medium brownish gray (10YR 8/2-6/2, rare 5/2). Faintly laminated marlstone with common fine silty laminae and streaks; some thick massive buff marly mudstone layers. Common high angle fractures with brown to tan earthy coatings and some patchy calcite crusts. Irregular shredded streaks and stringers of grayish-brown to black oil shale at 1,341.3-1,341.5.
1,346.2	1,348.2	Mudstone: Buff to rare medium brownish gray (10YR 7/2-6/2, rare 5/2). Thickly banded to finely laminated and streaked. Vertical fracture with earthy coatings through most of interval.
1,348.2	1,349.2	Oil shale: Light to medium brownish gray with some dark laminae and streaks (10YR 6/2-5/2, some 4/2-3/2). Distinct to faint laminae and streaks; slightly distorted in upper part. Some very fine black pyritic specks in upper part. Vertical fracture continues through interval. A 3/4-inch brown dolomite band at 1,348.7. [Sample of light to dark brownish-gray oil shale with some black specks from 1,348.5 feet: X-ray - quartz, dolomite, feldspar, analcite, dawsonite, pyrite.
1,349.2	1,351.2	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 4/2-4/3), rare satiny black streaks. Faint

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 3I-1 (Con.)

From	To	Description
		streaked bedding. Few thin brown dolomite streaks and stringers. Rare fine waxy black lenses and streaks (fossil fragments?).
1,351.2	1,352.6	Oil shale: Medium to some dark grayish brown (10YR 4/3-4/2, some 3/2 upper part). Moderately distinct to very faint streaked bedding. Rare fine black pyritic streaks and specks. Few thin to fine dolomite lenses and layers.
1,352.6	1,354.3	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 4/2-3/2, some 5/2); rare fine resinous black streaks near base. Faint to moderately distinct streaked bedding. A thin zone of very fine lacy black pyritic stringers at top. Some small gray smudgy patches and fine streaks in middle part.
1,354.3	1,355.4	Oil shale: Brownish gray (2.5Y and 10YR 5/2-4/2). Faint streaked bedding to very fine laminae. Rare very small dark gray pyritic blebs and streaks. Some short-tight high angle fractures. A 0.1-foot dense massive brownish-gray dolomite band at 1,354.6. Sample of brownish-gray oil shale from 1,355.1 feet: X-ray - quartz, dolomite, illite, analcite, feldspar, ferroan.
1,355.4	1,356.4	Oil shale: Medium to rare dark brownish gray (10YR and some 2.5Y 5/2-4/2, rare 3/2 lower part). Faintly laminated to very faintly streaked. Some fine dark gray pyritic streaks in upper part.
1,356.4	1,357.4	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, some 2/2). Faint streaked bedding and very fine laminae. Some <u>very</u> fine disseminated crystals and crystalline streaks. Rare fine dense dolomite layers with silty streaks. Sample of dark oil shale with some very fine disseminated crystals from 1,356.7 feet: X-ray - quartz, dolomite, illite, feldspar, analcite, ferroan, dawsonite.
1,357.4	1,359.6	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2 and 4/3, some 5/2 lower part). Faint very fine laminae and streaked bedding. Rare very fine crystals and crystalline streaks in upper part. Rare very fine dense dolomite streaks in lower part.

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,359.6	1,363.7	Oil shale: Brownish gray (10YR and 2.5Y 4/2-5/2). Faint very fine laminae and streaked bedding. Some vertical fractures with slight earthy coatings. Rare fine gray pyritic streaks. Medium to very dark grayish-brown oil shale at 1,361.0-1,361.3 with a 0.1 foot band of dense brownish-gray dolomite below; a 0.1-foot dolomite band at 1,363.3. Sample of dolomite band from 1,361.3 feet: X-ray - dolomite, quartz, feldspar, analcite, illite, ferroan.
1,363.7	1,365.2	Oil shale: Dark and rare medium brownish gray (10YR 3/2, rare 2/2 and 4/2). Very faint streaked bedding.
1,365.2	1,365.9	Oil shale: Very dark brownish gray to some black (10YR 2/2-3/2, some 1/2 in lower 3 inches); some satiny to resinous streaks at 1,365.6-1,365.7. Very faint streaked bedding; very fine smooth laminae in lower 0.1 foot. A 1-inch faintly layered brown very fine blebby-textured dolomite band at 1,365.7.
1,365.9	1,366.9	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 5/2 lower part). Faint to moderately distinct very fine laminae. Common fine grayish-brown dense blebby dolomite laminae and streaks in upper part. Sample of oil shale with fine blebby dolomite laminae and streaks from 1,366.0 feet: X-ray - dolomite, quartz, analcite, feldspar, illite, ferroan.
1,366.9	1,371.2	Oil shale: Medium to rare light brownish gray (10YR and 2.5Y 4/2-5/2, rare 6/2). Faint to moderately distinct laminae. Some fine gray pyritic streaks in upper half. A 2-inch faintly bedded dense grayish-brown dolomite band at 1,368.0; rare thin layers and streaks in lower part.
1,371.2	1,372.2	Oil shale: Dark and rare medium brownish gray (10YR 3/2, some 2/2, rare 4/2). Faint very fine laminae and streaked bedding. Rare fine dark gray pyritic streaks. A fine vitreous black organic streak at 1,372.1. Some very fine crystalline streaks in lower part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of oil shale with common very fine crystalline streaks from 1,371.9 feet: X-ray - quartz, dolomite, analcite, illite, feldspar, ferroan.
1,372.2	1,374.0	Oil shale: Medium and rare dark brownish gray (10YR 4/2-5/2, rare 3/2). Faintly laminated and streaked to banded; some fine displacements. Rare short tight vertical fractures.
1,374.0	1,375.3	Oil shale: Dark to some medium brownish gray (10YR 3/2, rare 2/2, some 4/2-4/3 lower part). Faint very fine laminae and streaked bedding. Some very fine grayish-brown dolomite laminae and streaks. Rare very fine gray silty streaks.
1,375.3	1,377.3	Mudstone and siltstone: Buff and some light brownish gray (10YR and 2.5Y 7/2-8/2, some 6/2). Faintly streaked and laminated to massive; wavy, broken, and displaced laminae at 1,376.8-1,377.0. High angle fracture in upper 0.7 foot.
1,377.3	1,378.9	Mudstone and marlstone: Light brownish gray to buff (10YR and 2.5Y 6/2-7/2, some 8/2). Faint to moderately distinct bands and laminae; some distorted and slightly displaced laminae and streaks. Occasional fine to thin dark brownish-gray crystalline streaks and layers with buff earthy material. Sample of mudstone with fine brownish-gray crystalline and buff earthy layer from 1,378.6 feet: X-ray - quartz, dawsonite, dolomite, feldspar.
1,378.9	1,379.9	Mudstone: Light to medium brownish gray and some buff (10YR and 2.5Y 6/2 and 6/3-5/2, some 7/2 near top). Faint streaked bedding and very fine laminae. Common fine gray silty streaks.
1,379.9	1,380.9	Oil shale: Medium to light brownish gray (10YR and 2.5Y 5/2-6/2, some 4/2). Faint very fine laminae and streaked bedding. A 1-1/2-inch brown dolomite lens at 1,380.5 with some short tight high angle fractures.
1,380.9	1,382.9	Oil shale: Medium to dark brownish gray (10YR 4/2 and some 5/2 upper part to 4/2 and 3/2 lower part). Faint

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 3I-1 (Con.)

From	To	Description
		streaked bedding and some very fine laminae. A 1-1/2-inch brown dolomite lens at 1,381.3; some thin to fine tan dolomite laminae at 1,382.3-1,382.4.
1,382.9	1,386.1	Oil shale: Dark and rare medium brownish gray (10YR 3/2, rare 4/2, some 2/2 lower part). Faint streaked bedding and rare laminae. Very rare fine dark gray silty pyritic blebs and streaks. Sample of dark brownish-gray oil shale from 1,385.0 feet: X-ray - quartz, feldspar, analcite, illite, dolomite, dawsonite, pyrite, ferroan.
1,386.1	1,388.0	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-5/2, some 4/3-5/3 near top). Faint to some moderately distinct streaked bedding. Rare fine dense dark gray silty-crystalline blebs and streaks. Rare fine to small grayish-brown dolomite nodules. Very fine waxy to vitreous black organic streak at 1,386.8.
1,388.0	1,389.0	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 4/2-3/2). Faint streaked bedding. Common fine to 1-inch brown dolomite streaks and nodules near top; some fine to thin streaks and nodules in lower part.
1,389.0	1,390.0	Oil shale: Medium and rare dark grayish brown (10YR 4/3-4/2, rare 3/2). Faint very fine laminae and streaked bedding.
1,390.0	1,393.2	Oil shale: Medium to very dark brownish gray (10YR and 2.5Y 4/2 and 4/3-2/2). Faint streaked bedding and some faint to moderately distinct laminae. Rare fine dense gray silty-crystalline blebs in upper part.
1,393.2	1,394.2	Oil shale: Medium to dark brownish gray (2.5Y 4/2-3/2, some 2/2 and 4/3). Faint streaked bedding and some faint to distinct laminae; common fine displacements.
1,394.2	1,395.2	Oil shale: Medium to some dark grayish brown (10YR and 2.5Y 4/3-4/2, some 3/2, rare 5/3 upper part). Faint very fine laminae and some streaked bedding; rare fine displacements. Rare fine to thin dark brownish-gray dense to silty-crystalline streaks and lenses. A very fine waxy black organic streak at 1,395.1.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,395.3	1,397.5	Oil shale: Dark and rare medium brownish gray (10YR 3/2, rare 4/2 and 2/2); very rare fine satiny to resinous streaks. Faint streaked bedding. Rare fine to small brown dolomite lenses. Rare very fine dark silty-crystalline streaks and blebs.
1,397.5	1,398.5	Oil shale: Dark and rare medium brownish brownish gray (10YR 3/2, rare 4/2, some 2/2 near base); some satiny luster near base. Faint streaked bedding. Slightly hackly fracture.
1,398.5	1,399.2	Oil shale: Dark to rare medium brownish gray (10YR 3/2, rare 4/2 and 2/2). Very faint streaked bedding. Some fine dense gray pyritic streaks at 1,398.9. A thin brown dolomite stringer with some gray pyritic blebs at 1,399.1.
1,399.2	1,400.0	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 4/2-3/2, some 2/2 and 5/2), rare satiny luster. Faint to moderately distinct laminae; some fine displacements.
1,400.0	1,401.8	Oil shale: Medium and some dark brownish gray (10YR and 2.5Y 4/2-5/2, some 3/2, some 4/3 lower part). Faint very fine laminae and some streaked bedding; some fine displacements.
1,401.8	1,402.3	Oil shale: Brownish gray and some tan to buff (10YR and 2.5Y 5/2, some 5/3-7/2). Moderately distinct to faint very fine laminae; common fine displacements. Common fine gray silty laminae and streaks. [Sample of oil shale with gray silty laminae and streaks from 1,402.1 feet: X-ray - dolomite, quartz, illite, feldspar, analcite.
1,402.3	1,406.0	Oil shale: Medium and rare dark brownish gray (10YR and 2.5Y 5/2-4/2, rare 3/2 lower part). Faint to moderately distinct laminae; common fine displacements. Fairly common fine gray silty streaks in upper part becoming rare in lower part. Rare small dolomite nodules in lower part.
1,406.0	1,408.0	Oil shale: Medium to rare dark brownish gray (10YR 4/2-5/2, rare 3/2, some 4/3-5/3 lower part).

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Faint to some moderately distinct laminae. Rare fine dense gray to brownish-gray streaks and layers. Sample of medium brownish-gray oil shale from 1,407.1 feet: X-ray - dolomite, quartz, illite, feldspar, analcite.
1,408.0	1,409.3	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2); rare fine black satiny to resinous streaks. Faint streaked bedding and some laminae. Rare fine dark silty streaks.
1,409.3	1,410.4	Oil shale: Dark and rare medium brownish gray (10YR 3/2-2/2, rare 4/2-4/3), rare satiny luster. Faint streaked bedding and very fine laminae. Coarse hackly fracture. Rare fine silty crystalline streaks and blebs.
1,410.4	1,414.3	Oil shale: Dark and rare medium brownish gray (10YR and 2.5Y 3/2-2/2, rare 4/2); common satiny to resinous luster from 1,412.0 to 1,413.6. Faint streaked bedding and some laminae. A thin grayish-brown dolomite layer at 1,411.0; rare fine streaks and blebs elsewhere. Sample of dark satiny to resinous oil shale from 1,412.8 feet: X-ray - quartz, dawsonite, illite, feldspar, dolomite, pyrite.
1,414.3	1,414.9	Oil shale: Grayish brown to tan (10YR 4/3-6/3). Faint streaked bedding; thin dark layer at 1,414.4. Sample of grayish-brown to tan oil shale from 1,414.5 feet: X-ray - dolomite; some quartz, feldspar.
1,414.9	1,416.0	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-4/2). Faint streaked bedding. Common fine grayish-brown dolomite streaks in upper part. Sample of dark brownish-gray (2.5Y 3/2) oil shale from 1,415.6 feet: X-ray - quartz, illite, dolomite, feldspar, analcite, calcite, pyrite.
1,416.0	1,417.6	Oil shale: Dark brownish gray to black (10YR and 2.5Y 3/2-1/2) with some grayish-brown to buff zones in upper part (10YR 4/3-7/2); some satiny luster. Faint

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		streaked bedding and some very fine laminae with distinct lighter zones at 1,416.1 (1-inch), 1,416.4 (3/4-inch), and 1,416.5 (1/2-inch); some fine to 1/8-inch diagonal fractures filled with dark oil shale crossing light zone at 1,416.4. Rare fine silty pyritic streaks and blebs.
1,417.6	1,418.8	Oil shale: Grayish brown to rare black (10YR 4/3-2/2, some 5/3, rare 1/2 and 2.5Y 4/2-5/2). Faint to moderately distinct, smooth to distorted streaked bedding. Rare fine silty pyritic streaks in dark zones. Rare fine to very small dark brownish-gray dense to silty-crystalline blebs. Sample of oil shale with small dense dark brownish-gray blebs from 1,418.5 feet: X-ray - quartz; some dolomite, analcite.
1,418.8	1,419.8	Oil shale: Dark brownish gray to some grayish brown (10YR and 2.5Y 3/2-2/2, some 4/3-5/3 lower part). Faint streaked bedding; some fairly distinct displaced laminae in lower part. Slightly hackly fracture. Rare fine dense dark brownish-gray streaks and blebs in lower part.
1,419.8	1,421.3	Oil shale: Black to dark brownish gray (10YR to 2.5Y 1/2-3/2), some satiny luster. Faint streaked bedding and very fine laminae. Very rare fine pyrite streaks.
1,421.3	1,422.5	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Very faint very fine streaked bedding.
1,422.5	1,423.5	Oil shale: Dark brownish gray to some black (10YR 3/2-2/2, some 1/2 lower part); some satiny luster in lower part. Very faint very fine streaked bedding.
1,423.5	1,425.3	Oil shale: Medium brownish gray to some black (10YR and 2.5Y 4/2 and 4/3-2/2, some 1/2). Faint streaked bedding to some moderately distinct laminae. Rare very fine dense to silty-crystalline blebs and streaks. A 4-inch tan slightly earthy dolomite (?) lens with some very short open fractures and fine irregular cavities at 1,424.0 and two 2-inch lenses in lower 0.3 foot. Sample of large tan dolomite(?) lens from 1,424.0 feet: X-ray - dolomite; trace quartz, feldspar.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,425.3	1,427.8	Oil shale: Dark brownish gray to some black (10YR 3/2-2/2, some 1/2 lower part). Very faint streaked bedding. Irregular coarse hackly fracture in lower part. Rare fine dark dense to silty blebs and streaks. Rare fine waxy to vitreous black organic streaks near base.
1,427.8	1,428.0	Dolomite: Grayish brown (10YR 4/3). Regular massive band. Some tight high angle fractures with dark resinous coatings.
1,428.0	1,428.6	Oil shale: Black to very dark brownish gray (10YR 1/2-2/2), rare satiny luster. Very faint very fine streaked bedding. Hackly fracture. Some very fine dark dense to silty-crystalline streaks. Very rare fish scales. [Sample of black oil shale from 1,428.2 feet: X-ray - quartz, illite, dolomite, feldspar, analcite, pyrite, ferroan.
1,428.6	1,430.2	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Faint very fine laminae. Regular thick to medium parting; slight to coarse stubby hackly fracture. Common fine brownish-gray crystalline layers and streaks in lower foot. [Sample of oil shale with fine crystalline layers and streaks from 1,429.7 feet: X-ray - aragonite, calcite, quartz, illite, pyrite, analcite, dolomite.
1,430.2	1,432.2	Oil shale: Dark brownish gray to some black (10YR 3/2-2/2, some 1/2 lower part). Faint <u>very</u> fine laminae and streaked bedding. Some very fine dark dense to silty streaks and rare small blebs. Thin brown dolomite layer at 1,431.5.
1,432.2	1,434.5	Oil shale: Dark brownish gray (10YR 3/2, some 2/2 upper part). Very faint streaked bedding. Rare fine dense to silty blebs.
1,434.5	1,436.0	Oil shale: Dark to medium brownish gray (2.5Y and 10YR 3/2-5/2). Very faint to fairly distinct streaked bedding. Rare fine to very small dark dense crystalline blebs. Some fine to small brown dolomite streaks and lenses in lower part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,436.0	1,438.0	Oil shale: Medium and some dark brownish gray to tan and buff (10YR 4/2 and 4/3-6/3 and 7/2, some 3/2). Faint to distinct distorted streaked bedding in thin to very thick darker and lighter zones with inter-fingered to shredded contacts. Some fine to small dark dense to silty-crystalline blebs.
1,438.0	1,440.3	Oil shale: Grayish brown with light and dark streaks (10YR 4/3-4/2 with 5/3-6/3 and 3/2-1/2 streaks). Distinct to faint streaked bedding. Rare fine dark dense silty-crystalline blebs in upper part. Sharp slightly irregular and hackly contact with dark oil shale below.
1,440.3	1,441.5	Oil shale: Very dark to some medium brownish gray (10YR 2/2-3/2, some 4/2-4/3 lower part). Very faint streaked bedding to moderately distinct laminae. Slightly hackly fracture in lower part. Rare 1/4-inch gas scales in upper part. Sample of very dark oil shale from 1,440.9 feet: X-ray - quartz, illite, feldspar, ferroan, dawsonite, pyrite, dolomite.
1,441.5	1,442.5	Oil shale: Dark to medium and rare light brownish gray (10YR 3/2-5/2, rare 2/2 and 6/2), some satiny to resinous luster. Faint to distinct laminae; common fine to thin loop structures and displacements. Fine to coarse, sharp to irregular hackly fracture.
1,442.5	1,443.7	Oil shale: Dark to medium brownish gray (2.5Y 3/2-5/2, some 3/1-4/1 upper part). Faint to moderately distinct laminae and some very faint streaked bedding. Some fine to thin dense light brownish-gray to buff layers. Sample of slightly brownish gray (2.5Y 3/1-4/1) oil shale from 1,442.6 feet: X-ray - quartz, illite, dolomite, analcite, pyrite, feldspar.
1,443.7	1,445.0	Oil shale: Medium to some light brownish gray and olive gray (2.5 to 5Y 4/2-5/2, some 5/1-6/1). Faint to distinct very fine laminae; very common very fine loop structures and displacements. Few thin dense buff to grayish-brown layers.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of medium to light olive-gray oil shale from 1,444.5 feet: X-ray - quartz, dolomite, illite, calcite, analcite, feldspar.
1,445.0	1,446.5	Oil shale: Brownish gray (2.5Y and 10YR 5/2-4/2). Faint streaked bedding. A 3/4-inch buff dolomite layer at 1,445.1
1,446.5	1,447.0	Oil shale: Medium to some dark grayish brown (10YR 5/3-4/3, some 3/2 lower part). Faint streaked bedding.
1,447.0	1,449.0	Oil shale: Grayish brown to black (10YR 4/3-1/2). Moderately distinct to faint laminae; common fine displacements in lower part. Slight to coarse hackly fracture.
1,449.0	1,449.7	Oil shale: Dark to medium grayish brown (10YR 3/2-4/3, rare 2/2 near top). Faint streaked bedding to nearly massive. Rare fine dense buff streaks.
1,449.7	1,450.5	Oil shale: Medium brownish gray and olive gray (2.5 to 5Y 5/2, some 4/2; 10YR 5/2 and 5/3-4/2 lower 0.3 foot). Faint streaked bedding; faint slightly irregular banding in lower part. Some fine gray silty streaks in upper part.
1,450.5	1,452.7	Oil shale: Buff and tan to grayish brown (2.5Y and 10YR 7/2 and 6/3 in upper part to 5/3 and 4/3 lower part). Faint to moderately distinct laminae; very common very fine loop structures and displacements. One-inch dense grayish-brown dolomite bands at top, 1,451.7 and 1,452.2.
1,452.7	1,454.8	Oil shale: Medium to dark brownish gray (10YR 4/2-4/3 and some 3/2 upper part to 4/2-3/2 and some 2/2 lower part). Moderately distinct to faint streaked bedding; some distorted bedding in upper part. Some small to 1-inch dolomite nodules and lenses.
1,454.8	1,455.0	Missing?
1,455.0	1,457.5	Oil shale: Very dark to rare medium brownish gray, some black in upper part (10YR 2/2-3/2, some 1/2

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		upper part, rare 4/2-4/3 mostly in lower part); some satiny luster in upper part. Faint and rare moderately distinct laminae to very faint streaked bedding. Common <u>very</u> fine crystalline streaks from 1,455.8 to 1,456.5; rare in other parts.
		Sample of oil shale with very fine crystalline streaks from 1,456.3 feet: X-ray - illite, quartz, analcite, dolomite, feldspar, ferroan, pyrite.
1,457.5	1,461.2	Oil shale: Buff and tan to brownish gray (10YR and 2.5Y 7/2 and 6/3-5/2 and 5/3) and medium to some dark grayish brown (10YR 4/3-4/2, some 3/2). Mostly finely laminated with common very fine loop structures and displacements in lighter zones; moderately distinct to faint streaked bedding in darker zones at 1,458.7-1,458.9, 1,459.6-1,460.0, and 1,460.7-1,461.2. Common thin brown dolomite streaks and lenses in darker zones. Rare fine to small, gray to dark brownish-gray blebs and nodules in darker and lighter zones. A 1-1/2-inch dense massive buff dolomite layer at 1,458.4; vertical fracture with very fine patchy dolomite crusts.
1,461.2	1,462.7	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2). Moderately distinct streaked bedding to faint very fine laminae. Some fine dark dense pyritic blebs and streaks. Rare fine to small tan dolomite streaks and nodules. Rare very fine crystalline streaks (like 1,456.3 feet?).
1,462.7	1,463.8	Oil shale: Dark brownish gray (10YR 2/2-3/2). Very faint very fine streaked bedding. Some fine dark brownish-gray silty pyritic streaks and blebs in upper part. Sample of oil shale with fine silty pyritic streaks and blebs from 1,462.8 feet: X-ray - quartz, marcasite, pyrite, illite, dolomite, feldspar.
1,463.8	1,464.9	Oil shale: Dark to medium brownish gray and rare tan to buff (10YR and 2.5Y 3/2-4/2, some 5/2-5/3, rare 6/3-7/2). Very faint streaked bedding and some fairly distinct laminae; very common fine displacements in lower part. Some very fine irregular dark gray streaks and very short fracture fillings in lower part.

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From	To	Description
1,464.9	1,465.9	Oil shale: Dark and some medium brownish gray (10YR 3/2-2/2, some 4/2-4/3). Very faint streaked bedding.
1,465.9	1,467.5	Oil shale: Very dark brownish gray (10YR 2/2, some 3/2). Very faint streaked bedding to very fine laminae. A thin dense grayish-brown dolomite layer at 1,467.1.
1,467.5	1,468.7	Oil shale: Dark and some medium brownish gray (10YR 3/2-2/2, some 4/2-4/3). Faint streaked bedding and very fine laminae. Rare very fine dark gray streaks.
1,468.7	1,469.4	Oil shale: Medium and some dark brownish gray (10YR 4/2-5/2, some 3/2 upper part). Faint streaked bedding to nearly massive.
1,469.4	1,470.6	Oil shale: Brownish gray to tan and some buff (10YR and 2.5Y 4/2 and 4/3-6/3, some 7/2). Moderately distinct very fine commonly displaced laminae to faint streaked bedding. Some fine to thin, light to dark brownish-gray, dense to silty-crystalline streaks and lenses.
1,470.6	1,474.0	Oil shale: Medium to rare dark brown, common tan to buff in middle (10YR 4/3 and 4/4-5/3, common 6/3-7/2 in middle, rare 3/2); some very dark slightly satiny streaks near base. Faint to distinct streaked bedding; distinct commonly displaced laminae in middle. Some small to fine, medium to dark brownish-gray, silty-crystalline to very dense nodules, blebs, and irregular streaks becoming fairly abundant in middle part. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of thin dark dense to silty-crystalline streak with some oil shale from 1,471.2 feet: X-ray - quartz, analcite, dolomite, feldspar. </div>
1,474.0	1,475.8	Oil shale: Dark brownish gray to black (10YR 3/2-1/2). Very faint streaked bedding and very fine laminae. Common <u>very</u> fine crystalline streaks (like 1,456.3 feet). A thin hackly stringer of medium grayish-brown oil shale injected about one inch into interval from above.
1,475.8	1,477.0	Oil shale: Black to grayish brown (10YR 1/2-4/3). Faint streaked bedding with common fairly distinct

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		fine to thin dense grayish-brown laminae; common fine to thin displacements.
1,477.0	1,479.5	Oil shale (?): Medium brownish gray and olive gray to some grayish brown (2.5 to 5Y 4/2-5/2 and 5/1, some 5/3-4/3 lower part). Nearly massive to faintly streaked. Some fine to very small dense tan to gray nodules and rare thin stringers. Sample of massive slightly olive gray oil shale from 1,477.2 feet: X-ray - quartz, dolomite, feldspar, illite, analcite, ferroan, pyrite.
1,479.5	1,481.5	Oil shale: Grayish brown to tan, some dark brownish gray in lower part (10YR 5/3 and 5/2-6/3 and 6/2, some 4/3-3/2 lower part). Faint streaked bedding to moderately distinct laminae with very common very fine loop structures and displacements. Some very small to fine, dense to silty gray blebs and lenses.
1,481.5	1,482.5	Oil shale: Medium to very dark brownish gray and rare black (10YR 4/2-2/2, rare 1/2), rare satiny luster near base. Moderately distinct to faint laminae and streaked bedding. Some fine dark dense to silty blebs. Common <u>very</u> fine crystalline streaks near base.
1,482.5	1,484.6	Oil shale: Very dark brownish gray (10YR 2/2 and 2/1-3/2 and 3/1). Faint streaked bedding and very fine laminae. Some very fine crystalline streaks in upper part. Two-inch faintly banded dark brownish-gray fairly dense dolomite (?) layer at top; 1-inch faintly laminated grayish-brown dolomite band at 1,484.1.
1,484.6	1,487.6	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 5/2 lower part). Faint very fine laminae and streaked bedding; some fine displacements. High angle fractures with varnish-like coatings at 1,484.6-1,484.8 and 1,486.5-1,486.9. Very rare fine vitreous black organic streaks in lower part. Very thin dense and slightly silty lamina at 1,487.2 and a very thin dense brownish-gray dolomite lamina 1/2 inch lower.
1,487.6	1,489.0	Oil shale: Light to medium brownish gray and rare tan to buff (10YR 6/2-5/2, rare 6/3-7/2). Moderately distinct laminae. High angle fractures with slight

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		earthy to varnish-like coatings and some very fine brownish-black coatings throughout interval. Uneven sample split.
1,489.0	1,491.0	Oil shale (?): Medium to light slightly brownish and olive gray (2.5 to 5Y 5/1 and 5/2-6/1 and 6/2). Faintly laminated and streaked to banded. Hard and tight; fairly smooth to conchoidal fracture. High angle fractures with earthy to varnish-like coatings through most of interval. Sample of hard tight slightly brownish gray rock from 1,489.2 feet: X-ray - quartz, dolomite, feldspar, dawsonite, ferroan, pyrite, illite.
1,491.0	1,496.0	Mudstone: Buff to light and very rare medium brownish gray (2.5Y 8/2-6/2, rare 5/2). Distinct to faint, thin to very fine streaked bedding in upper part to faint and rare distinct laminae in lower part. Common thin to very fine, brownish-gray to gray silty streaks. Slightly irregular vertical fractures with brown earthy coatings and dirty brown to black resinous patchy organic crusts from top to 1,493.5.
1,496.0	1,498.0	Mudstone (oil shale?): Light to medium brownish gray (2.5Y to 10YR 6/2-5/2, very rare 4/2). Faint to some moderately distinct laminae. Common fine gray silty streaks. Vertical fracture with earthy brown coatings and dark brown resinous patchy crusts in lower half foot.
1,498.0	1,499.0	Oil shale: Brownish gray to buff (10YR 5/2-8/2, some 4/2-4/3 near base). Very fine distinct laminae. Common fine gray silty streaks. Vertical fracture continues through interval.
1,499.0	1,501.0	Marlstone: Buff to some tan and rare grayish brown (10YR 8/2-7/2, some 6/3, rare 5/3-4/3). Faint and rare distinct laminae becoming wavy to distorted and discontinuous in lower part. Common light to medium brownish-gray dense and silty streaks to small blebs and short irregular vertical stringers. Vertical fractures as above and below in upper and lower 0.2 foot.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of marlstone with very abundant silty blebs and stringers from 1,500.2 feet: X-ray - quartz, dolomite, calcite, feldspar, dawsonite.
1,501.0	1,503.0	Marlstone and mudstone: Buff to tan and some grayish brown (10YR 8/2-6/3, some 5/3 and rare 4/3 in lower part). Faint to fairly distinct irregular displaced laminae and streaked bedding. Common silty streaks and blebs as above. Discontinuous vertical fractures with brown fine-grained crystalline coatings through most of interval. Uneven sample split.
1,503.0	1,508.6	Oil shale: Buff to medium and rare dark brown (10YR 7/2-5/3 and 5/4, some 4/3-4/2, very rare 3/2, some 8/2 bands in upper part). Distinct to faint laminae with very common fine displacements; some faintly streaked to nearly massive zones.
1,508.6	1,509.6	Oil shale: Tan to medium and some dark grayish brown (10YR 6/3 and 5/3 upper part to 4/3 and some 3/2 lower part). Faintly streaked in upper part to laminated in lower part. Rare very fine dark gray silty pyritic streaks in lower part. Some 1/2-inch dense brown to tan dolomite lenses at base. Sample of grayish-brown oil shale from 1,509.4 feet: X-ray - quartz, dolomite, feldspar, analcite, dawsonite, ferroan.
1,509.6	1,518.0	Oil shale: Buff and tan to grayish brown (10YR 7/2 and 6/3-5/3, some 8/2, very rare 4/3). Faint to fairly distinct very fine laminae--commonly finely wavy and discontinuous. Very abundant fine to very small silty blebs, streaks, and some short irregular high angle stringers (like 1,500.2 feet). Common high angle fractures below 1,512.5--frequently with very rough surfaces with abundant fine to fairly coarsely crystalline calcite.
1,518.0	1,522.0	Oil shale: Buff to medium and very rare dark grayish brown (10YR 7/2-5/3, rare 4/3-3/2). Fairly distinct to faint discontinuous laminae and streaked bedding. Common fine silty blebs and streaks in upper part. Some discontinuous tight high angle fractures in lower part.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,522.0	1,524.1	Oil shale: Medium to some dark grayish brown (10YR 5/3-4/3 upper part to 4/3-3/2 lower part). Moderately distinct very fine laminae to very faint streaked bedding. Rare short tight high angle fractures in upper part.
1,524.1	1,525.2	Oil shale: Very dark brownish gray (10YR 2/2-3/2). Faint streaked bedding and some very fine laminae. Common very fine disseminated crystals and crystal-line streaks. Occasional fine dense grayish-brown dolomite laminae and streaks. [Sample of oil shale with very abundant very fine crystalline streaks from 1,524.3 feet: X-ray - quartz, dolomite, analcite, illite, feldspar, ferroan.
1,525.2	1,527.4	Oil shale: Grayish brown to buff (10YR 5/3-8/2, some 4/3). Fairly distinct to faint very fine laminae; common very fine loop structures and displacements. Common fine gray-buff to light gray dense silty streaks and blebs in lighter zones. Rare short tight high angle fractures.
1,527.4	1,530.0	Oil shale: Grayish brown to buff (10YR 5/3-7/2, some 8/2 upper part, some 4/3 lower part). Distinct to some faint very fine laminae; common very fine loop structures and displacements. Some very fine satiny to waxy black organic streaks and stringers at 1,529.5.
1,530.0	1,531.0	Oil shale: Grayish brown and some tan to buff (10YR 5/3 and 5/2-4/3 and 4/2, some 6/3-7/2 upper part). Moderately distinct very fine laminae; common fine loop structures and displacements. Thin dense grayish-brown dolomite streak at 1,530.7.
1,531.0	1,531.8	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3-3/2, very rare 2/2). Moderately distinct to faint very fine laminae and streaked bedding; rare very fine loop structures and displacements. Few thin irregular dense dolomite layers and streaks.
1,531.8	1,534.1	Oil shale: Medium to rare dark brownish gray and some grayish brown (10YR 5/2-4/2, rare 3/2, some 5/3-4/3

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		upper part). Moderately distinct to faint very fine discontinuous laminae and streaked bedding. Rare fine dark gray discolored streaks. Very rare fine tan dolomite streaks.
1,534.1	1,535.1	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, rare 2/2 lower part). Faint streaked bedding and very fine discontinuous laminae. Rare fine pyritic streaks and blebs. A thin dense brownish-gray dolomite streak at 1,534.7 and a thin irregular layer at 1,534.8. [Sample of medium to dark oil shale from 1,534.9 feet: X-ray - dolomite, quartz, analcite, feldspar, illite.
1,535.1	1,535.6	Oil shale: Medium and very rare dark grayish brown (10YR 4/3 and 4/2-5/3 and 5/2, rare 3/2). Faint very fine laminae; some fine displacements. Rare very fine light brownish-gray dense silty streaks. A very irregular thin brown dolomite stringer with common tight irregular fractures and rare fine cavities at top.
1,535.6	1,537.0	Marlstone and mudstone: Buff to light and some medium grayish brown (10YR 7/2-6/2, some 8/2, and 5/3, rare 4/3). Faint to distinct laminae and some faintly streaked to massive zones; some very fine loop structures and displacements. Few very fine waxy to vitreous black organic streaks at 1,536.7. [Sample of buff mudstone from 1,536.0 feet: X-ray - dolomite, quartz, feldspar, analcite.
1,537.0	1,541.0	Marlstone and lean oil shale: Buff to tan and rare grayish brown (10YR 8/2-6/2 and 6/3, rare 5/3-4/3), Slightly silty in upper part. Faint to some distinct laminae and some very finely streaked zones; common very fine loop structures and displacements. Vertical fracture with finely mottled brown coatings in lower 0.2 foot.
1,541.0	1,544.4	Oil shale: Tan and some buff to medium and rare dark grayish brown (10YR 6/3 and 6/2-4/3, some 7/2, rare

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From	To	Description
		3/2-2/2). Moderately to very distinct laminae with very common very fine loop structures and displacements; becoming irregularly streaked in lower 0.3 foot. Abundant very thin irregular dolomite streaks and blebs at 1,542.1; a large irregular dolomite lens at base with some fine dark round crystals concentrated in thin streaks and blebs. Sample of distinctly laminated oil shale from 1,543.8 feet: X-ray - dolomite, quartz, analcrite, feldspar, illite. Sample of dolomite with abundant fine dark round crystals from 1,544.4 feet: X-ray - dolomite, quartz, analcrite, feldspar.
1,544.4	1,545.6	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/3 upper part to 3/2 lower part), rare satiny black streaks near base. Faint very fine streaked bedding. Some fine dolomite streaks and blebs.
1,545.6	1,546.6	Oil shale: Dark brownish gray to black (10YR 3/2-1/2). Faint streaked bedding and some very faint laminae. Irregular hackly fracture. Sample of very dark oil shale from 1,546.3 feet: X-ray - quartz, illite, analcrite, dolomite, feldspar, ferroan, pyrite.
1,546.6	1,547.6	Oil shale: Dark to some medium brownish gray (10YR 3/2-2/2, some 4/2). Faint streaked bedding and some laminae; Slightly irregular shaly to papery parting in middle part. A fine displaced yellowish-buff silty lamina with abundant very fine pyritic blebs at 1,547.0.
1,547.6	1,548.3	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2 and 4/3). Faint streaked bedding and very fine laminae. Irregular coarse hackly fracture. Some fine dolomite laminae and streaks in lower part.
1,548.3	1,548.8	Oil shale: Medium brownish gray (10YR to 2.5Y 4/2-5/2). Faint streaked bedding and very fine laminae. Rare fine tan dolomite streaks. Abundant very fine silty laminae and streaks near base.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,548.8	1,550.8	Mudstone and marlstone: Light and rare medium brownish gray to buff and gray buff (10YR and 2.5Y 6/2-7/2 and 7/1, rare 5/2-5/3). Faintly laminated and streaked to banded; common fine to thin displacements; very distorted bedding in upper 0.2 foot.
1,550.8	1,553.0	Mudstone and siltstone: Buff and gray buff to light brownish gray (2.5Y 7/2 and 7/1-6/2). Faint slightly irregular laminae and some very faintly streaked to massive zones. Some fine gray silty streaks.
1,553.0	1,557.3	Mudstone and some marlstone: Buff to light and rare medium brownish gray (2.5Y and 10YR 7/2-6/2, rare 5/2). Faint to some moderately distinct laminae; some distorted and displaced zones. Some fine gray silty streaks.
1,557.3	1,558.8	Mudstone: Light to very rare medium brownish gray (2.5Y 6/2, rare 6/1 and 5/2). Massive to faintly laminated. Some gray silty streaks.
1,558.8	1,562.0	Mudstone and some marlstone: Light some medium brownish gray (2.5Y 6/2 and 6/1, some 5/2). Faint very fine laminae and rare massive bands; some fine to 1/4-inch displacements and rare very fine loop structures. Some gray silty streaks.
1,562.0	1,564.0	Oil shale: Light to medium brownish gray (2.5Y and 10YR 6/2-5/2). Massive to faintly laminated; some fine displacements. Rare fine dense dark gray blebs and streaks. Some irregular natural (?) fractures in upper part.
1,564.0	1,565.8	Oil shale: Medium to rare light brownish gray (10YR 5/2, some 4/2, rare 6/2). Faint streaked bedding and some laminae. Some very small dense medium to dark brownish-gray blebs and streaks.
1,565.8	1,566.8	Oil shale: Medium to rare dark brownish gray (10YR 4/2-4/3, some 5/2, rare 3/2). Faint streaked bedding and some laminae. Some fine dense round blebs and lenses.

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1,566.8	1,568.0	Oil shale: Dark brownish gray to some black (10YR 3/2-2/2, some 1/2), rare satiny luster. Faint streaked bedding and <u>very</u> fine laminae. Some <u>very</u> fine disseminated crystals and crystalline streaks in lower part. [Sample of very dark oil shale from 1,567.8 feet: X-ray - quartz, dolomite, feldspar, illite, analcite, ferroan, pyrite.
1,568.0	1,569.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Faint very fine laminae and streaked bedding. Rare very fine disseminated crystals and crystalline streaks.
1,569.0	1,571.0	Oil shale: Medium and some dark brownish gray (10YR and 2.5Y 4/2, some 3/2 upper part, rare 5/2). Faint very fine laminae. Slightly irregular thick to some thin parting. A thin wavy gray to tan dense silty layer at top. Vertical fracture with abundant very fine chalky white specks in upper 0.4 foot.
1,571.0	1,573.0	Oil shale: Brownish gray (10YR and 2.5Y 4/2-4/1). Faint very fine laminae and medium to thick massive bands. Rare fine gray pyritic streaks.
1,573.0	1,577.2	Oil shale: Medium to some dark brownish gray (10YR 4/2, some 3/2 lower part). Nearly massive to faintly streaked and laminated. Irregular natural (?) vertical fracture with gray-buff to brown earthy coatings in upper 1.2 feet.
1,577.2	1,578.2	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 2/2). Faint to moderately distinct laminae.
1,578.2	1,578.3	Dolomite: Light brownish gray (10YR 6/1-6/2). Abundant very fine slightly irregular and wavy medium to dark brownish-gray oil-shale laminae.
1,578.3	1,580.0	Siltstone and mudstone: Light and rare medium brownish gray to buff and gray buff (10YR and 2.5Y 6/2 and 6/1-8/2 and 8/1, rare 5/2). Moderately distinct to faint, distorted to fairly regular laminae and streaks.

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From	To	Description
1,580.0	1,588.9	Mudstone and marlstone (some lean oil shale): Buff to some medium and very rare dark brownish gray (10YR 8/2-7/2, some 5/2 and 5/3, rare 4/2-3/2). Faint to some fairly distinct very fine regular to distorted laminae and streaks; rare massive bands. Common fine gray and rare brownish-gray silty streaks. High angle fractures with tan to dark brown mottled coatings in upper 3-1/2 feet. Some rounded core ends in lower part.
1,588.9	1,590.3	Oil shale: Buff to brownish gray (10YR 7/2-5/2 and 5/3, rare 4/2-4/3), silty. Fairly distinct to faint very fine slightly irregular laminae; common fine loop structures and displacements. Irregular to rounded core ends.
1,590.3	1,603.0	Missing. P2 157053
1,603.0	1,604.2	Mudstone: Buff to tan and some grayish brown (10YR 8/2-6/3, some 5/3, rare 4/3). Faintly laminated; common very fine loop structures and displacements; becoming faintly streaked in lower 0.2 foot. [Sample of buff to tan mudstone from 1,603.4 feet: X-ray - dolomite, quartz, feldspar, calcite, analcite, illite.
1,604.2	1,605.2	Mudstone: Buff (10YR 7/2). Massive to faintly streaked.
1,605.2	1,609.0	Oil shale: Medium and rare dark grayish brown to buff (10YR and 2.5Y 4/3-7/2, rare 3/2 lower part). Fairly distinct to faint, regular to irregular laminae and streaks. Some gray silty streaks from 1,605.9 to 1,606.2. A 1-inch dense brown dolomite band at 1,606.3 and a 3/4-inch band at 1,606.9. Rare short tight vertical fractures. [Sample of grayish-brown oil shale from 1,605.7 feet: X-ray - dolomite, quartz, analcite, feldspar, illite.
1,609.0	1,610.0	Marlstone and mudstone: Buff to rare light and medium grayish brown (10YR 7/2-8/2, rare 6/2-5/3). Faintly laminated to massive.
1,610.0	1,611.0	Marlstone (oil shale?): Light brownish gray (10YR 6/2). Very faint streaked bedding; rare fine dark oil-shale stringers in upper part. Rare very small dense light to medium brownish-gray blebs.

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,611.0	1,612.5	Oil shale: Buff to light and some medium grayish brown (10YR 7/2-6/2 and 6/3, some 5/2-5/3). Faint irregular streaked bedding to very fine laminae with common very fine loop structures. Rare very fine gray streaks.
1,612.5	1,614.0	Oil shale: Light to medium grayish brown and some buff (10YR 6/2-5/3, some 7/2 and 4/3). Fairly distinct laminae with very common fine displacements to some very faint streaked bedding.
1,614.0	1,614.8	Oil shale: Grayish brown (10YR 5/3-4/3). Very faint streaked bedding; some very fine dark streaks near base. Rare fine to very small dark dense crystalline blebs.
1,614.8	1,616.4	Oil shale: Dark brownish gray to black (10YR 3/2-2/2; common 1/2 from 1,615.0 to 1,615.5); some satiny luster in very dark zone. Faint streaked bedding. Very abundant <u>very</u> fine crystalline streaks in very dark zone. Natural (?) vertical fracture with muddy brown coatings in upper 0.8 foot. <div style="margin-left: 40px;">Sample of black oil shale with very fine crystalline streaks from 1,615.0 feet: X-ray - quartz, illite, analcite, dolomite, ferroan, feldspar.</div>
1,616.4	1,617.0	Oil shale: Medium to light grayish brown (10YR 4/3 upper part to 5/3 and 6/3-6/2 lower part). Very faintly streaked in upper part to finely laminated in lower part. Some fine gray silty streaks in lower part.
1,617.0	1,624.0	Mudstone and siltstone: Buff to light and rare medium brownish gray (10YR and 2.5Y 8/2-6/2, rare 5/2 and 5/3-4/3). Faint to some moderately distinct laminae and streaked bedding; common very fine loop structures and displacements. Common light to medium gray silty streaks. Rare discontinuous tight high angle fractures.
1,624.0	1,626.0	Mudstone and marlstone: Buff to light and rare medium brownish gray (2.5Y 8/2-6/2, rare 5/2). Faintly laminated; common very fine loop structures.
1,626.0	1,628.0	Marlstone and mudstone (lean oil shale): Buff to grayish brown (10YR and 2.5Y 8/2-5/3, very rare 4/3).

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Fairly distinct laminae with common fine loop structures and displacements in upper 0.5 foot; very faint to some fairly distinct streaked bedding in other parts; some distorted zones.
1,628.0	1,632.0	Oil shale: Grayish brown to buff (2.5Y and 10YR 5/3 and 5/2-7/2, rare 8/2 and 4/3). Faint to moderately distinct laminae alternating with very thick very faintly streaked zones. High angle fracture with very slight brown coatings from 1,629.3 to 1,629.8. Rare fine to small, gray to dark brownish-gray streaks and blebs in lower part.
1,632.0	1,635.7	Oil shale: Medium to rare dark grayish brown (10YR 5/3, some 4/3 and rare 3/2 lower part), some thin black streaks in lower 0.2 foot. Very faint streaked bedding. Some fine to small dense gray to brownish-black blebs and streaks. Sample of oil shale with very small dense medium to dark brownish-gray blebs from 1,634.1 feet: X-ray - dolomite, quartz, analcite, feldspar, illite, pyrite.
1,635.7	1,639.3	Oil shale: Very dark brownish gray and some black (10YR 2/2-3/2, some 1/2); some satiny luster mostly in upper half. Faint streaked bedding and some very fine laminae. Fine to coarse hackly fracture; some shaly parting. Very abundant very fine crystalline streaks in upper half (like 1,615.0 feet) becoming sparse in lower part.
1,639.3	1,640.3	Oil shale: Medium and some dark brownish gray (10YR 4/2-5/2 and 5/3, some 3/2-2/2). Faint streaked bedding and very fine discontinuous laminae. Irregular coarse hackly fracture. Some fine dense brownish-gray streaks and small blebs--occasionally with pyritic rims.
1,640.3	1,642.7	Oil shale: Dark and some medium brownish gray (10YR 3/2, some 2/2 and 4/2-4/3), rare satiny luster. Faint streaked bedding. Some fine to small, medium to dark brownish-gray dense streaks and blebs.
1,642.7	1,645.7	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2, some 3/2 upper and lower parts), some satiny luster. Very faint streaked bedding and some very fine laminae. Fine to coarse hackly fracture and some

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		shaly parting in lower half. Rare fine to small dense black blebs and streaks. Very abundant very fine crystalline streaks from 1,644.4 to 1,645.0 (like 1,615.0 feet). Vertical fracture with muddy brown coatings from 1,643.4 to 1,644.4.
1,645.7	1,647.0	Oil shale: Dark and some medium brownish gray (10YR and 2.5Y 3/2-2/2, some 4/2). Faint streaked bedding and very fine laminae. Irregular thick to papery parting; hackly fracture. Rare fine pyrite lenses. Faintly laminated dense brownish-gray dolomite in upper 3 inches. Rare diagonal glossy shear surfaces. Sample of papery shale from 1,646.0 feet: X-ray - illite, dolomite, quartz, feldspar, analcite, pyrite.
1,647.0	1,655.0	Claystone and marlstone: Light and some medium brownish gray to buff (2.5Y 6/2 and 6/1-7/2, some 10YR 6/2-5/2 in lower part). Faintly laminated and streaked with fairly common very thick to thin massive bands; fairly common fine to 1/2-inch displacements. Slightly conchoidal to very irregular fracture; slightly unctuous. Some gray streaks and layers.
1,655.0	1,658.0	Oil shale: Medium and some light brownish gray (10YR and 2.5Y 5/2 and 5/1-6/2 in upper part to 5/2 and 4/2 in lower part). Faint thin to very fine laminae. Irregular thick to medium parting (slightly unctuous); irregular very coarse hackly fracture.
1,658.0	1,662.5	Oil shale: Medium to dark brownish gray (2.5Y 4/2-3/2, rare 5/2). Faint very fine laminae. Regular to irregular, shaly to rare papery parting (slightly unctuous); very hackly fracture. Rare diagonal glossy shear surfaces. Rare fine gray pyritic streaks in upper part.
1,662.5	1,663.5	Oil shale: Medium to very dark brownish gray (10YR 4/2-5/2 in upper half, 4/2 and 4/3-2/2 lower half). Very faint streaked bedding in upper part to faint laminae with some fine displacements in lower part. Sample of dark brownish-gray oil shale from 1,663.3 feet: X-ray - illite, dolomite, quartz, feldspar, analcite, pyrite.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,663.5	1,664.4	Oil shale: Medium to some dark grayish brown and buff (10YR 4/3-5/3, some 3/2-2/2 and 6/3-7/2). Faint to distinct very fine laminae and streaks. Rare thin displaced dense grayish-brown dolomite layers and small lenses.
1,664.4	1,665.6	Marlstone: Buff to tan (10YR 8/2-6/3), slightly silty in lightest parts. Moderately distinct very fine laminae and some thin to 1-inch bands; common very fine loop structures. Some irregular masses and thin layers of dense sparry brownish-gray dolomite in upper part; bedding passes through irregular masses without interruption. Few fine dense black blebs at 1,664.5.
1,665.6	1,667.0	Oil shale: Tan to buff and rare brown (10YR 6/3-8/2, rare 5/3-5/4). Distinctly laminated to very faintly streaked. A thin dense dolomite layer at 1,666.1.
1,667.0	1,667.8	Marlstone: Like 1,664.4-1,665.6.
1,667.8	1,668.8	Oil shale: Buff to brown (10YR 7/2-5/3 and 5/4, some 4/3 and 8/2). Gradationally banded with very faint streaked bedding and some very fine laminae with loop structures. Irregular high angle fracture with some patchy brown earthy coatings through most of interval.
1,668.8	1,669.8	Mudstone: Very light buff (10YR 8/2, some 7/2). Faint very fine laminae; common very fine loop structures. Rare fine chalky white and dense brownish-gray streaks and blebs. <div style="margin-left: 40px;"> { Sample of mudstone with some fine brownish-gray and rare white blebs from 1,669.5 feet: X-ray - dolomite, quartz, feldspar. </div>
1,669.8	1,671.4	Marlstone: Buff to some tan (10YR 8/2-7/2, some 6/3), slightly silty. Faint to moderately distinct laminae; common very fine loop structures and displacements. Rare fine brownish-gray and white blebs as above.
1,671.4	1,673.4	Oil shale: Buff to brown (10YR 8/2-5/3, very rare 4/3), slightly silty in lightest parts. Distinctly laminated; common fine loop structures and displacements. Rare fine dense brownish-gray and chalky white blebs in upper part. Irregular 2-inch buff mudstone layer near base.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,673.4	1,674.2	Oil shale: Medium to rare dark grayish brown (10YR 5/3-4/3 and 4/2, rare 3/2). Moderately distinct to faint streaked bedding. Some fine to thin, buff to brownish-gray dolomite streaks, stringers, and blebs. Very rare fine medium to dark brownish-gray silty blebs.
1,674.2	1,675.5	Oil shale: Light to medium brownish gray (10YR and 2.5Y 6/2-4/2 and 4/3). Faint streaked bedding; thick slightly unconformable darker and lighter stringers in lower part. Some fine to very small, dense to very fine crystalline, light to dark brownish-gray streaks and blebs.
1,675.5	1,676.5	Oil shale: Medium and some dark grayish brown to tan (10YR 4/3-5/3, some 3/2 and 6/3). Faint streaked bedding in thick conformable darker and lighter zones. Rare fine to small, very irregular to round dense medium to dark brownish-gray blebs.
1,676.5	1,678.5	Oil shale: Medium and rare dark grayish brown to tan and some buff (10YR 4/3-5/3, some 7/2, rare 6/3, some 6/1-5/1 at 1,677.1-1,677.3). Distinct to faint laminae and some distorted streaked bedding. Some fine to 3/4-inch dense medium to dark brownish-gray blebs and small gray silty blebs in lower part. [Sample of small dense dark brownish-gray blebs from 1,677.9 feet: X-ray - quartz, trace dolomite.
1,678.5	1,680.0	Oil shale: Dark and rare medium brownish gray to black (10YR 3/2-1/2, rare 4/2-4/3 upper part). Very faint streaked bedding. Irregular coarse hackly fracture. Very regular natural vertical fracture through most of interval.
1,680.0	1,685.8	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2). Faint streaked bedding and some <u>very</u> fine laminae. Irregular to regular, thick to shaly and rare papery parting; irregular to very hackly fracture. Some thick grayish-brown dolomitic zones. Common fine dense brownish-gray streaks at 1,680.4. Rare fine to small dense dark brownish-gray blebs (like 1,677.9 feet). Some broken core with muddy brown coatings in lower part.
1,685.8	1,687.8	Oil shale: Very dark brownish gray and some black to some medium grayish brown (10YR 2/2-3/2, some 1/2;

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		4/3-5/3 at 1,687.5-1,687.6). Faint streaked bedding and very fine laminae. Shaly to papery parting and hackly fracture in upper part to fairly regular thick parting and slightly conchoidal fracture in lower part. A 1-1/2-inch dense grayish-brown dolomite band with faint slightly displaced laminae at 1,686.5. Rare very small dark brownish-gray silty nodules in lower part.
		[Sample of very dark papery oil shale from 1,686.3 feet: X-ray - illite, quartz, ferroan, feldspar, dolomite, pyrite.
		[Sample of very dark firm oil shale from 1,687.7 feet: X-ray - dolomite, quartz, illite, analcite.
1,687.8	1,689.0	Oil shale: Tan to grayish brown and light to medium brownish gray (10YR 6/3-5/3 and 2.5Y 6/2-5/2). Faint laminae and streaked bedding; common very fine displacements and rare loop structures. Common very fine buff slightly earthy streaks. Some fine dense brownish-gray blebs.
1,689.0	1,689.6	Oil shale: Brownish gray (2.5Y 5/2). Very faint streaked bedding. Common fine buff earthy blebs and streaks with dense brownish-gray centers.
1,689.6	1,690.0	Oil shale: Medium to rare dark brownish gray (10YR 5/2-4/2, rare 3/2). Faint very fine laminae and streaked bedding. Some fine to small, dense to silty, tan to dark brownish-gray streaks and blebs.
1,690.0	1,691.6	Oil shale: Dark and some medium brownish gray (10YR 3/2, some 4/2, rare 2/2). Very faint streaked bedding and some very fine laminae. Irregular thick to some thin parting; irregular coarse hackly fracture; slightly unctuous. Some natural diagonal to vertical fractures.
1,691.6	1,693.8	Oil shale: Dark brownish gray (10YR 3/2-2/2). Very faint streaked bedding and very fine laminae. Irregular thick parting; irregular very coarse hackly fracture; slightly unctuous. Rare very fine silty pyritic streaks in upper part. Some glossy shear surfaces in lower part.
1,693.8	1,694.8	Oil shale: Dark brownish gray (10YR and 2.5Y 3/2). Faint very fine laminae and streaked bedding. Shaly

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		to rare papery parting; hackly fracture; slightly unctuous. Very rare fine gray silty pyritic streaks. [Sample of dark brownish-gray shale from 1,694.5 feet: X-ray - dolomite, illite, quartz, feldspar, analcite, pyrite.
1,694.8	1,697.0	Oil shale: Medium grayish brown and brownish gray to buff (10YR 5/3-7/2 and 2.5Y 5/2 and 5/1-7/2 and 7/1). Faint to moderately distinct laminae; common very fine loop structures and displacements. Small to 1-inch dense brown dolomite nodules at contact with dark shale above; some thin light brownish-gray to buff dolomite layers in middle part. Grayer zones are slightly silty.
1,697.0	1,698.0	Oil shale: Grayish brown to tan (2.5Y and 10YR 5/3-6/3, rare 4/3). Faint to moderately distinct very fine laminae and streaked bedding. Common slightly irregular thin to fine buff marlstone layers and streaks from 1,697.4 to 1,697.8.
1,698.0	1,700.0	Mudstone and marlstone (oil shale?): Brownish gray to gray buff and grayish brown to buff (2.5Y and 10YR 5/2-7/1 and 5/3-8/2). Faint to fairly distinct laminae with common very fine loop structures and displacements; faintly streaked in upper 0.3 foot. Regular vertical fracture with orange-tan earthy coatings through most of interval. [Sample of light to medium slightly brownish gray mudstone from 1,699.5 feet: X-ray - quartz, dolomite, calcite, illite, feldspar, analcite.
1,700.0	1,701.3	Oil shale: Medium to light grayish brown and brownish gray to some buff (10YR and 2.5Y 5/3 and 5/2-6/3 and 6/2, some 7/2-8/2, rare 5/1). Moderately distinct laminae; common very fine loop structures and displacements.
1,701.3	1,702.1	Mudstone: Very light buff (10YR 8/2). Very faint <u>very</u> fine laminae and streaks.
1,702.1	1,705.0	Mudstone and marlstone (lean oil shale): Buff to tan and some brown (10YR 8/2-6/3 and 6/4, some 5/3-5/4). Faint to distinct laminae; very common very fine loop structures and displacements.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,705.0	1,706.0	Marlstone: Very light buff to some light brownish gray (10YR and 2.5Y 8/2, some 7/2-6/2), slightly silty. Faintly banded to very finely laminated; common very fine loop structures and displacements; 1-inch very displaced and slightly disoriented zone at 1,705.8 (almost a mosaic breccia). <div style="margin-left: 2em;">Sample of very light slightly silty marlstone from 1,705.5 feet: X-ray - dolomite, quartz, calcite, analcite, feldspar.</div>
1,706.0	1,707.0	Oil shale: Buff to tan and rare medium grayish brown (10YR and 2.5Y 7/2-6/3, rare 5/3). Faint to moderately distinct laminae; common very fine loop structures and displacements; some very distorted and displaced zones. Rare fine gray silty streaks and blebs.
1,707.0	1,709.0	Oil shale: Buff to medium and very rare dark grayish brown (10YR 7/2-5/3, rare 4/3-3/2) and some light to medium slightly olive gray (2.5 to 5Y 6/1-5/1). Faint to moderately distinct streaks and displaced laminae.
1,709.0	1,711.0	Oil shale: Buff to medium and rare dark grayish brown (10YR and 2.5Y 7/2-5/3, some 4/3, rare 3/2). Faint to moderately distinct laminae; common fine loop structures and displacements. Some very small to fine brownish-gray, dense to slightly silty blebs in lower part.
1,711.0	1,714.0	Oil shale: Medium and rare dark grayish brown to some buff (10YR and 2.5Y 4/3-5/3, some 6/3-7/2, rare 3/2-2/2). Faint to distinct laminae; common very fine loop structures and displacements.
1,714.0	1,717.0	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, some 2/2). Faint laminae and streaked bedding; rare fine displacements. Irregular thick to medium parting and coarse hackly fracture in lower part. Rare fine dark brownish-gray dense to silty blebs.

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Laramie Energy Research Center, Laramie, Wyoming

May 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of medium to dark oil shale from 1,714.3 feet: X-ray - dolomite, quartz, illite, analcite, feldspar.
1,717.0	1,719.0	Oil shale: Very dark to some medium brownish gray (10YR 2/2 and 3/2 in upper part to 2.5Y 3/2 and some 4/2 lower part). Very faint streaked bedding and some laminae. Irregular thick to very thin parting; irregular coarse to sharp hackly fracture; becoming slightly unctuous in lower part. A 1-1/2-inch hard dense massive brownish-gray dolomite band at base. Sample of dark slightly unctuous shale from 1,718.3 feet: X-ray - illite, quartz, analcite, feldspar, dolomite, pyrite.
BOTTOM OF PARACHUTE CREEK MEMBER		
1,719.0	1,726.0	Claystone (oil shale?): Medium brownish gray (2.5Y 4/1 and 4/2-5/1 and 5/2). Faint very fine laminae; some fine displacements. Irregular to some fairly regular, thick to medium parting; very irregular coarse hackly fracture; slightly unctuous. Some irregular broken core pieces.
1,726.0	1,727.0	Claystone (oil shale?): Medium to light brownish gray (2.5Y and 10YR 5/2-6/2, rare 4/2). Faint very fine laminae; some fine displacements. Irregular thick parting; coarse hackly to slightly irregular fracture; slightly unctuous. Sample of medium to light brownish-gray claystone from 1,726.7 feet: X-ray - dolomite, quartz, illite, calcite, feldspar, pyrite.
1,727.0	1,730.7	Oil shale: Medium to some light brownish gray (2.5Y 5/2, some 6/2-6/1, rare 10YR 5/2-4/2). Faintly laminated and streaked to some nearly massive zones. Irregular to slightly conchoidal fracture. Rare dense silty gray streaks. Some tight high angle fractures with resinous brown patches in upper part.
1,730.7	1,732.0	Oil shale: Medium brownish gray (2.5Y and 10YR 5/2-4/2, some 5/3-4/3). Faint to some moderately distinct

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Laramie Energy Research Center, Laramie, Wyoming

May 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		laminae; some fine to thin displacements. Rare fine buff to gray-buff slightly silty streaks. <div> <div>Sample of brownish-gray oil shale from 1,731.3 feet: X-ray - dolomite, quartz, illite, feldspar, calcite.</div> </div>
1,732.0	1,734.2	Oil shale: Medium to light brownish gray (2.5Y and 10YR 4/2-6/2, some 5/1-6/1). Moderately distinct to faint laminae; some fine displacements and irregular pinched laminae. Slightly silty in grayer parts.
1,734.2	1,736.6	Oil shale: Medium to some light brownish gray and rare buff (10YR and 2.5Y 4/2-5/2, some 6/2, rare 7/2 upper part). Fairly distinct to faint laminae; common fine displacements in lower part. Some fine light gray slightly silty streaks and laminae. Some irregular fractured core pieces with orange-brown muddy coatings in upper part.
1,736.6	1,739.0	Oil shale (claystone and mudstone): Medium to light brownish gray (2.5Y and 10YR 4/2 and 4/1-6/2 and 6/1). Moderately distinct to faint laminae; common fine to thin displacements. Common silty laminae and streaks in upper part becoming sparse in lower part.
1,739.0	1,740.0	Oil shale: Dark to light brownish gray and some buff (2.5Y 3/2-6/2, some 4/1-5/1 upper part, some 7/2 lower part). Faint to distinct laminae; rare fine displacements. Very common fine light gray to gray-buff silty laminae and streaks in upper part becoming fairly sparse in lower part. <div> <div>Sample of dark to medium brownish-gray oil shale with light silty laminae and streaks from 1,739.5 feet: X-ray - quartz, K and Na feldspars, illite, dolomite, ferroan, pyrite.</div> </div>
1,740.0	1,741.0	Marlstone and mudstone (oil shale?): Buff to slightly brownish gray (2.5Y 7/2-4/1). Moderately distinct laminae to very thickly banded. Rare fine light silty streaks in upper part.
1,741.0	1,742.7	Mudstone and marlstone (oil shale?): Medium to light and some dark brownish gray (2.5Y 4/1 and 4/2-6/2),

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		some 3/1 upper part). Very faint to moderately distinct laminae in upper and lower parts to faintly streaked and massive in middle. Fairly common fine to thin light silty laminae and streaks in upper and lower parts.
1,742.7	1,746.4	Mudstone: Gray (N 5, some 4; some very slight brown tint). Very faintly bedded to massive. A 2-inch irregular brownish-gray dolomite band with common dark platy fragments at top. Some broken core with muddy coatings in lower part.
1,746.4	1,747.8	Mudstone: Gray and some brownish gray (N 4-5, some 10YR 4/1-5/1). Faintly laminated to massive.
1,747.8	1,751.0	Mudstone: Brownish gray and gray (10YR 4/1-5/1 and N 4-5). Faintly laminated. Some fine to thin light gray siltstone layers and streaks. Fractured and broken core with muddy brown coatings from 1,748.6 to 1,750.0.
1,751.0	1,753.0	Siltstone: Medium to some light gray (N 5, some 6, rare 4 upper part). Massive to very faintly bedded; some faint laminae near top.
1,753.0	1,760.8	Mudstone: Gray (N 5-4; some very slight brown tint). Very faintly bedded to massive.
1,760.8	1,766.0	Mudstone: Medium to some dark slightly brownish gray (N 5-4, some 3). Faint to moderately distinct laminae and bands. Common light gray siltstone laminae. Irregular thick to medium parting; irregular to coarse hackly fracture.
1,766.0	1,766.7	Mudstone: Medium to light gray (N 5-6). Very faintly laminated and banded. Hard and tight.
1,766.7	1,768.0	Mudstone: Like 1,760.8-1,766.0.
1,768.0	1,770.0	Mudstone: Like 1,753.0-1,760.8.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,770.0	1,775.0	Mudstone and claystone: Medium to light slightly brownish gray (N 4-6). Faint to fairly distinct laminae. Irregular thick to rare thin parting; very irregular coarse hackly fracture.
1,775.0	1,776.6	Claystone and mudstone; Medium to dark slightly brownish gray (N 5-3). Faintly laminated and banded. Irregular thick to some thin parting; irregular coarse hackly fracture; slightly unctuous. Sample of gray claystone from 1,775.9 feet: X-ray - quartz, illite, feldspar, calcite, ferroan, pyrite, dolomite.
1,776.6	1,778.0	Mudstone: Gray (N 4-5). Massive. Fairly hard and tight; irregular to conchoidal fracture. Very rare very fine dark brown resinous blebs. [Sample of fairly hard gray mudstone from 1,777.4 feet: X-ray - dolomite, quartz, illite, feldspar, calcite, pyrite, ferroan.
1,778.0	1,784.0	Claystone: Medium gray and brownish gray (N 4-5 and 10YR 4/1-5/1). Faint very fine laminae and streaked bedding; some massive zones in upper part. Irregular thick to some thin parting; very irregular coarse hackly fracture; slightly to moderately unctuous. Rare broken core with muddy coatings.
1,784.0	1,785.0	Claystone and mudstone: Medium and rare dark gray (N 4-5, rare 3; some very slight brown tint). Irregular thick to medium parting; irregular coarse hackly fracture.
1,785.0	1,799.0	Claystone and shale: Medium to rare light and dark gray and brownish gray (N 4-5, rare 3 and 2.5Y 4/1-5/1, rare 3/1 and 6/1). Faintly laminated; rare massive zones. Irregular thick to thin parting; irregular hackly fracture; slightly to moderately unctuous. A 2-inch hard dense grayish-brown dolomite band at 1,790.6.
1,799.0	1,806.0	Claystone and shale: Medium to some dark and rare light brownish gray (10YR and 2.5Y 4/1-5/1, some 3/1, rare 6/1). Faint to rare moderately distinct

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		laminae. Irregular thick to thin parting; irregular hackly fracture; unctuous. (Looks like oil shale but grab sample gave trace oil in test tube).
1,806.0	1,811.4	Shale: Medium and some dark brownish gray (10YR and 2.5Y 4/1-5/1, some 3/1). Faintly laminated. Irregular thin to thick parting; hackly fracture; moderately to slightly unctuous. (Grab sample gave trace oil in test tube.)
1,811.4	1,814.5	Claystone and shale: Medium and rare dark brownish gray (2.5Y 4/1 and 4/2-5/1 and 5/2, rare 3/1). Faint very fine laminae and streaked bedding. Irregular thick to thin parting; irregular coarse hackly fracture; slightly unctuous. Rare black fish scales and rib fragments near top. (Grab sample gave small amount of oil in test tube.) Sample of brownish-gray shale from 1,813.8 feet: X-ray - illite, quartz, dolomite, feldspar.
1,814.5	1,820.0	Claystone: Medium to light slightly olive gray and brownish gray (5Y 5/1-6/1 and 2.5Y 5/1 and 5/2-6/1 and 6/2). Faint very fine laminae and some streaked bedding. Irregular thick to rare thin parting; irregular very coarse hackly fracture; slightly unctuous.
1,820.0	1,821.1	Claystone and marlstone: Medium brownish gray to buff and some slightly olive gray (2.5Y 5/2-7/2, some 5Y 5/1). Faintly laminated; rare fine to 1/2-inch displacements. Irregular to fairly regular, thick to medium parting; irregular to some hackly fracture; slightly unctuous. Sample of medium to light brownish-gray marlstone from 1,820.9 feet: X-ray - dolomite, quartz, illite, analcite, feldspar.
1,821.1	1,822.0	Oil shale: Medium to some dark brownish gray and rare brown to tan (2.5Y 5/2 and 5/1-4/2, some 3/2, rare 5/3-6/3). Faint to rare distinct laminae. Irregular thick to thin parting; hackly fracture. Very rare fine waxy black organic streaks. Sample of dark brownish-gray oil shale from 1,821.7 feet: X-ray - illite, quartz, feldspar, dolomite, analcite, pyrite.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,822.0	1,822.9	Claystone: Medium slightly brownish gray (2.5Y 5/1-4/1, some 5/2-4/2 lower part). Faint streaked bedding and very fine laminae. Irregular thick parting; irregular and some coarse hackly fracture; slightly unctuous.
1,822.9	1,825.0	Oil shale: Medium to dark brownish gray (2.5Y 5/2 and 5/1-3/2, some 2/2). Faint very fine laminae and streaked bedding. Irregular thick to very thin parting; hackly fracture. A fine pinch-and-swell dark dense layer at 1,823.1. <div> Sample of oil shale with fine dense layer from 1,823.1 feet: X-ray - quartz, analcite, illite, feldspar, ferroan, pyrite, dolomite. </div>
1,825.0	1,828.0	Oil shale: Dark and some medium brownish gray (2.5Y 3/2-2/2, some 4/2-4/1). Faint streaked bedding and very fine laminae. Irregular to regular, shaly to some papery parting; hackly fracture; unctuous.
1,828.0	1,832.0	Oil shale: Brownish gray (2.5Y 4/2-5/2, slight olive tint in middle part). Faint very fine laminae. Irregular shaly parting; hackly fracture; unctuous. Very rare fine black fossil fragments.
1,832.0	1,833.0	Oil shale: Grayish brown (2.5Y and 10YR 4/3-4/2). Very faintly bedded. Irregular parting and fracture. Rare very fine dark dense blebs (probably like 1,823.1 feet). <div> Sample of grayish-brown oil shale from 1,832.4 feet: X-ray - dolomite, quartz, feldspar, illite, pyrite. </div>
1,833.0	1,834.6	Oil shale: Medium to dark brownish gray (2.5Y 4/2-3/2). Very faint streaked bedding and very fine laminae. Fairly regular to irregular shaly parting; coarse hackly fracture; slightly unctuous.
1,834.6	1,837.0	Oil shale: Medium to light brownish gray (10YR and 2.5Y 5/2-6/2, rare 4/2). Faintly laminated to massive. Irregular thick parting; irregular and some conchoidal fracture; fairly dense. Some fine dark dense to crystalline blebs and streaks. Rare short tight vertical fractures.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of light brownish-gray oil shale with crystalline blebs from 1,835.0 feet: X-ray - dolomite, barite, analcite, quartz.
1,837.0	1,838.2	Oil shale: Medium to dark brownish gray (2.5Y 4/2-3/2, rare 2/2). Faint streaked bedding. Irregular shaly parting; hackly fracture. Rare fine dark dense blebs and streaks. Dense medium to light brownish-gray oil shale as above in lower 3 inches. Irregular vertical fracture through most of interval is probably artificial.
1,838.2	1,840.6	Oil shale: Dark and some medium brownish gray to rare black (2.5Y and 10YR 3/2-2/2, some 4/2 and 4/3, rare 1/2). Very faint streaked bedding to faint and some moderately distinct very fine laminae. Irregular to fairly regular, thick to very thin parting; hackly fracture. Rare fine dark dense blebs and streaks. Very rare fine black fossil fragments.
1,840.6	1,841.7	Oil shale: Medium to light grayish brown (10YR and 2.5Y 5/3-6/2, rare 4/3). Faint to rare distinct very fine laminae; some fine loop structures and displacements. Irregular very thick parting; irregular to conchoidal fracture. Rare fine dark dense streaks and blebs. Some very fine buff streaks and laminae in lower part.
1,841.7	1,843.7	Oil shale: Dark to medium brownish gray and olive gray (2.5 to 5Y 3/2-5/2). Faint streaked bedding and very fine laminae in thick gradational darker and lighter zones. Irregular to fairly regular thick parting; slight coarse hackly fracture. Rare fine dark dense to silty streaks and blebs. Rare fine columnar ("silky") pyrite streaks with gray to black sooty material. [Sample of "silky" pyrite from 1,842.5 feet: X-ray - pyrite.
1,843.7	1,844.7	Oil shale: Dark to medium brownish gray (2.5Y 3/2-4/2, some 10YR 4/2 lower part). Faint streaked bedding. Irregular thick to medium parting; slight to coarse

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		hackly fracture. Some very fine dense to silty grayish-brown streaks and blebs. Rare fine "silky" pyrite streaks.
1,844.7	1,845.9	Oil shale: Grayish brown to some tan (10YR and 2.5Y 4/3 and 4/2-6/3 and 6/2). Faint to rare distinct laminae and some very faint streaked bedding. Irregular parting and fracture. Some fine dark dense to crystalline blebs in upper part (like 1,835.0 feet?). Vertical fracture with very fine patchy chalky buff crusts at 1,845.3-1,845.6. Dark brownish-gray oil-shale band at 1,845.6-1,845.7.
1,845.9	1,846.9	Oil shale: Medium to dark brownish gray and some black (10YR 4/2-2/2, some 1/2). Very faint streaked bedding in medium to thin fairly regular to finely interfingered medium and dark zones. Some fine to very small dark dense to silty-crystalline blebs.
1,846.9	1,848.5	Oil shale: Very dark slightly brownish gray (10YR 2/2-2/1). Very faint streaked bedding. Slightly irregular thick parting; slightly hackly fracture. Abundant very fine dark dense to silty blebs and streaks in upper part becoming sparse in lower part. A very fine vitreous black organic layer at 1,847.8. <div style="margin-left: 40px;">Sample of oil shale with abundant very fine silty-crystalline streaks from 1,847.1 feet: X-ray - quartz, illite, analcite, feldspar, dolomite, pyrite, ferroan.</div>
1,848.5	1,850.5	Oil shale: Dark to some medium brownish gray (10YR 3/2-2/2, some 4/2). Faint streaked bedding. Fairly regular thick to thin parting; slight to rare coarse hackly fracture. Very rare fine dense dark to medium brownish-gray streaks.
1,850.5	1,852.9	Oil shale: Medium and some dark brownish gray to grayish brown (10YR 4/2 and some 3/2 in upper part to 4/2 and 4/3 lower part). Faint streaked bedding and very fine laminae. Irregular thick to some thin parting; irregular coarse hackly fracture; slightly unctuous. Irregular diagonal glossy shear surface at 1,851.3. <div style="margin-left: 40px;">Sample of grayish-brown oil shale from 1,852.4 feet: X-ray - dolomite, quartz, illite, feldspar.</div>

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,852.9	1,856.0	Oil shale: Medium brownish gray and some olive gray (2.5Y 4/2-5/2 and some 5Y 4/2-5/2). Very faint slightly distorted streaked bedding. Irregular thick parting; very irregular very coarse hackly fracture; slightly to moderately unctuous. Vertical fracture with very slight varnish-like coatings through most of interval. Uneven sample split. [Sample of olive-gray oil shale from 1,854.6 feet: X-ray - dolomite, quartz, illite, feldspar.
1,856.0	1,857.0	Oil shale: Medium and some dark brownish gray (2.5Y 4/2, some 3/2). Faint streaked bedding. Irregular thick to rare thin parting; irregular hackly fracture. Some fine dense to silty blebs and streak. Very rare very fine "silky" pyrite streaks.
1,857.0	1,858.0	Oil shale: Medium to very dark brownish gray (2.5Y and 10YR 4/2-2/2). Faint streaked bedding. Some fine to very thin dark dense to crystalline streaks and blebs.
1,858.0	1,859.0	Oil shale: Dark brownish gray (10YR 2/2-3/2). Very faint streaked bedding. Abundant very fine dark dense to silty-crystalline streaks and blebs (like 1,847.1 feet).
1,859.0	1,860.0	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-4/2). Very faint streaked bedding becoming very finely laminated in lower part. Slightly irregular thick parting; irregular coarse to fine and sharp hackly fracture. Some very fine silty-crystalline streaks.
1,860.0	1,861.0	Oil shale: Medium and some dark brownish gray (2.5Y 4/2, some 3/2). Faint streaked bedding. Irregular thick to medium parting; coarse hackly to irregular fracture. A regular 1/2-inch massive olive-gray band near top. [Sample of massive olive-gray band from 1,860.0 feet: X-ray - illite, quartz, ferroan, feldspar, pyrite, dolomite.
1,861.0	1,864.0	Oil shale: Dark to medium brownish gray (2.5Y and 10YR 2/2-4/2). Faint streaked bedding and very fine

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		laminae. Fairly regular thick to thin parting; slight to coarse hackly fracture. Common very fine crystalline streaks in some zones in upper half (like 1,847.1 feet). Some broken core in lower part.
1,864.0	1,865.0	Oil shale: Dark and rare medium brownish gray (10YR and 2.5Y 2/2-3/2, rare 4/2). Very faint streaked bedding; some very fine distinct light gray laminae in lower part. Fairly regular thick parting; slightly hackly fracture. Rare very fine dense to silty-crystalline streaks.
1,865.0	1,866.5	Oil shale: Dark to some medium brownish gray (2.5Y 2/2-3/2, some 4/2, rare 5/2-5/1). Very faint to some moderately distinct very fine laminae. Regular to irregular, thin to thick parting. Very rare fine pyrite streaks. Some broken and mixed up core with vertical muddy fracture surfaces.
1,866.5	1,867.5	Oil shale: Dark brownish gray (2.5Y and 10YR 2/2-3/2). Faint streaked bedding and very fine laminae. Regular thick to thin parting. Vertical fracture with muddy coatings through interval.
1,867.5	1,869.6	Oil shale: Medium to some dark brownish gray and grayish brown (2.5Y and 10YR 5/2 and 5/3-4/2 and 4/3, some 3/2). Faint streaked bedding and very fine laminae; some thick banding in upper part. Irregular broken core pieces in upper part; thick to thin parting and coarse hackly fracture in lower part.
1,869.6	1,870.6	Oil shale: Very dark brownish gray to some black (10YR 2/2, some 3/2 and 1/2). Very faint streaked bedding and some laminae. Fairly regular thick to thin parting; coarse hackly fracture. Very rare small dark dense blebs.
1,870.6	1,871.6	Oil shale: Dark brownish gray (10YR 3/2, some 2/2 upper part). Faint streaked bedding. Regular thick to rare thin parting; coarse hackly fracture. Rare fine dark dense blebs.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,871.6	1,873.6	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-4/2). Faint streaked bedding and very fine laminae. Fairly regular to irregular, thick to thin parting; coarse to some sharp hackly fracture. Some very fine crystalline streaks. Sample of oil shale with very fine crystalline streaks from 1,872.6 feet: X-ray - quartz, illite, analcite, feldspar, pyrite, ferroan, dolomite.
1,873.6	1,875.0	Claystone and oil shale: Medium to some light gray claystone (N 5, some 6) and medium to dark brownish-gray oil shale (2.5Y 4/2-3/2). Banded to laminated claystone with common very fine distinct brownish-gray laminae; a thin very finely laminated oil-shale band at 1,873.9 and a very thick zone at 1,874.2-1,874.7. Irregular thick to some thin parting; irregular to coarse hackly fracture. Sample of gray claystone from 1,873.7 feet: X-ray - quartz, illite, dolomite, feldspar, pyrite, ferroan.
1,875.0	1,876.2	Oil shale: Dark to medium brownish gray (2.5Y and 10YR 3/2-4/2). Faint very fine laminae. Regular to irregular, medium to thin parting; slightly irregular to coarse hackly fracture.
1,876.2	1,877.8	Claystone with few thin oil-shale zones: Like 1,873.6-1,875.0 feet.
1,877.8	1,879.1	Oil shale: Like 1,875.0-1,876.2 feet with common very fine gray claystone laminae and rare thin bands.
1,879.1	1,881.8	Oil shale: Medium to very dark brownish gray (2.5Y and 10YR 4/2-2/2). Faint very fine laminae and streaked bedding. Fairly regular to irregular, thick to some thin parting; irregular coarse hackly fracture. Rare black fossil fragments. A 1-inch hard dense brownish-gray dolomite (?) band at 1,880.4.
1,881.8	1,882.1	Dolomite: Grayish brown to brownish gray (10YR 5/3 upper part to 4/2 and 4/1 lower part). Very fine blebby texture in upper half; dense and massive in lower half. A thin slightly irregular dark oil-shale layer 3/4 inch above base. Regular contacts

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		with oil shale above and below. Irregular high angle fracture with slight oily stains in upper half.
		Sample of grayish-brown blebby dolomite from 1,881.9 feet: X-ray - dolomite, analcite, feldspar, quartz, ferroan.
		Sample of dense massive brownish-gray dolomite from 1,882.0 feet: X-ray - dolomite; some quartz, analcite, feldspar.
1,882.1	1,886.0	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 4/2-2/2, some 5/2). Faint streaked bedding to faint and rare distinct laminae. Irregular thin to thick parting; sharp to coarse hackly fracture. Rare thin to fine brownish-gray dolomite layers and streaks in upper half.
1,886.0	1,887.3	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 2/2). Faint very fine laminae and streaked bedding. Irregular thick to medium parting; irregular slight to coarse hackly fracture.
1,887.3	1,890.3	Oil shale: Very dark to medium brownish gray (10YR 2/2-4/2). Faint streaked bedding and faint to some moderately distinct very fine to thin laminae. Fairly regular thick to thin parting; irregular slight to rare coarse hackly fracture. Rare fine silty pyrite blebs and streaks. Abrupt change from dark to lighter oil shale at base.
1,890.3	1,890.6	Oil shale: Medium brownish gray (10YR and 2.5Y 5/2-4/2). Very faint streaked bedding; fairly distinct very fine displaced laminae in upper 1/2 inch. Some fine dark silty pyritic blebs in lower part. (Core ends at base do not fit together.)
1,890.6	1,894.0	Oil shale: Dark to medium grayish brown (10YR 3/2-4/3). Very faint streaked bedding. Irregular parting and fracture. Fairly abundant fine and rare small dark dense to silty-crystalline blebs. A very fine black cealy streak with columnar ("silky") pyrite and some very fine adamantina acicular to lath-shaped crystals at 1,893.8.
		Sample of small dark dense bleb with some oil shale from 1,892.4 feet: X-ray - quartz.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of black pyritic streak with very fine acicular crystals from 1,893.8 feet: X-ray - pyrite.
1,894.0	1,896.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Faint streaked bedding. Irregular to regular, thick to some thin parting; irregular to coarse hackly fracture. Some very fine to rare thin dark dense to silty-crystalline streaks.
1,896.0	1,897.0	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 4/2-3/2, rare 5/2-5/3). Faint streaked bedding and very fine laminae. Regular to irregular, thick to thin parting; irregular hackly fracture. Some very fine crystalline streaks in upper part. A 1-inch massive dark gray pyritic stringer at 1,896.7. Sample of dark gray stringer from 1,896.7 feet: X-ray - analcite, marcasite, pyrite, feldspar.
1,897.0	1,900.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faint streaked bedding and some very fine laminae. Regular to very irregular, thick to thin parting; irregular hackly fracture. Rare fine to thin dark dense streaks and blebs. A very thin buff tight sandy-textured layer at 1,897.5 with a very fine yellowish-buff earthy layer at top.
1,900.0	1,901.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2). Faint very fine laminae and streaked bedding. Irregular thick to thin parting; hackly fracture. Some very thin to fine dark dense streaks and blebs. A very thin irregular pale yellow earthy to silty layer with dense buff blebs at 1,900.3. Sample of thin pale yellow layer with small amount of oil shale from 1,900.3 feet: X-ray - ferroan, feldspar, analcite, mixed layer clay, kaolin, quartz.
1,901.0	1,902.2	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2), some satiny luster. Very faint streaked bedding. Slightly irregular thick parting; irregular fracture. Occasional fine to small dark dense to silty blebs and streaks.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,902.2	1,903.9	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2 upper part); some satiny and rare resinous luster. Faint to moderately distinct streaked bedding in thick darker and lighter zones. Some small to fine dark dense blebs and streaks.
1,903.9	1,906.8	Oil shale: Dark and some medium brownish gray (10YR and 2.5Y 3/2, some 4/2 upper part). Faint streaked bedding and some very fine laminae. Slightly irregular thick to some thin parting; slightly irregular to rare hackly fracture. Rare fine dark to medium brownish-gray, dense to silty and pyritic streaks.
1,906.8	1,907.1	Oil shale: Grayish brown (10YR 4/2-5/3), dolomitic. Faintly streaked to massive. Slightly conchoidal fracture. Some irregular tight high angle fractures in lower part. [Sample of grayish-brown oil shale from 1,907.0 feet: X-ray - dolomite, quartz.
1,907.1	1,913.0	Oil shale: Medium to dark brownish gray (2.5Y and 10YR 4/2-3/2). Faint very fine laminae and streaked bedding. Irregular to fairly regular, thick to medium parting. Abundant ostracods (?) on some parting surfaces.
1,913.0	1,914.5	Oil shale: Brownish gray (10YR 4/2-4/1). Faint very fine laminae. Regular to irregular, medium to thick parting.
1,914.5	1,915.7	Oil shale: Dark to some medium brownish gray (10YR 3/2-3/1, some 4/2-4/1). Faint very fine laminae and streaked bedding. Regular thick to some thin parting. Common very fine dark crystalline streaks. [Sample of oil shale with very fine crystalline streaks from 1,915.2 feet: X-ray - quartz, illite, analcite, pyrite, feldspar, dolomite.
1,915.7	1,916.5	Oil shale: Medium to dark grayish brown (10YR 4/3-3/2, rare 5/3). Faint very fine laminae. Slightly irregular thick parting; slightly conchoidal to irregular fracture.
1,916.5	1,917.5	Oil shale: Very dark brownish gray (10YR 2/2-3/2). Faint streaked bedding. Irregular thick parting;

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		slightly irregular and hackly fracture. Rare fine dark dense to silty-crystalline streaks and blebs.
1,917.5	1,918.5	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Very faint streaked bedding. Irregular to regular, thick to medium parting; irregular slight to coarse hackly fracture.
1,918.5	1,922.5	Oil shale: Brownish gray (10YR to 2.5Y 4/2). Faint streaked bedding. Regular to irregular, thick to thin parting; irregular coarse hackly fracture. Rare glossy shear surfaces. Very rare "silky" pyrite streaks in upper part. Artificial (?) vertical fractures throughout.
1,922.5	1,924.0	Oil shale: Brownish gray (10YR and 2.5Y 4/2-4/3). Faint streaked bedding. Irregular parting and fracture. Some fine dark silty blebs and streaks. Artificial (?) vertical fracture through most of interval.
1,924.0	1,925.6	Oil shale: Brownish gray and grayish brown (2.5Y and 10YR 5/2 and 5/3-4/2 and 4/3). Faint laminae and streaked bedding; contorted in middle part. Irregular parting and fracture. Fine dull black streak with abundant very fine adamantine lath-shaped crystals at top. <div style="margin-left: 40px;">Sample of regularly laminated brownish-gray oil shale from 1,924.2 feet: X-ray - dolomite, quartz, illite, feldspar.</div>
1,925.6	1,926.6	Oil shale: Brownish gray (2.5Y and 10YR 4/2). Faint streaked bedding. Some fine dark silty blebs and streaks.
1,926.6	1,927.8	Oil shale: Medium to dark brownish gray, some brown in lower part (10YR 4/2-3/2, rare 2/2, some 4/3-4/4), rare satiny luster. Faint streaked bedding to very fine laminae. Fairly regular thick parting; slightly irregular and conchoidal fracture. Rare very fine crystalline streaks.
1,927.8	1,928.8	Oil shale: Very dark brownish gray (10YR 2/2-3/2), some satiny luster. Faint streaked bedding and very

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		fine laminae; Regular thick to some thin parting; very slight to some sharp hackly fracture. Some fine dark dense streaks. Some thin zones with abundant very fine dark crystalline streaks in upper part (like 1,915.2 feet).
		[Sample of very dark oil shale from 1,928.4 feet: X-ray - quartz, illite, dolomite, feldspar, pyrite.
1,928.8	1,930.0	Oil shale: Dark and rare medium brownish gray (10YR 3/2-2/2, rare 4/2-4/3), rare satiny luster. Faint and rare moderately distinct very fine laminae to very faint streaked bedding. Fairly regular to irregular thick parting; slight coarse hackly fracture. Rare fine dense to silty-crystalline streaks.
1,930.0	1,931.0	Oil shale: Dark brownish gray (10YR 3/2-2/2). Faint streaked bedding. Rare fine dark dense streak. Broken core and rubble; uneven sample split.
1,931.0	1,932.0	Oil shale: Dark brownish gray (10YR 3/2). Very faint streaked bedding. Irregular to fairly regular, thick to medium parting; irregular coarse hackly fracture. Rare fine dark silty pyritic blebs and streaks.
1,932.0	1,934.4	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2, some 3/2); common satiny to some resinous luster. Faint streaked bedding and some very fine laminae. Rare fine dark dense to silty streaks and blebs. Few thin zones with abundant very fine crystalline streaks in upper part.
1,934.4	1,936.5	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2 upper part); some very fine resinous black streaks in lower part. Faint very fine laminae and streaked bedding. Rare fine to thin dark dense streaks and blebs. Some irregular glossy shear surfaces in middle part. Grayish-brown dolomitic zone in lower 2 inches. [Sample of very thin dark dense streak with some oil shale from 1,934.6 feet: X-ray - quartz, ferroan, trace dolomite.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,936.5	1,937.7	Oil shale: Dark and some medium brownish gray (10YR and 2.5Y 3/2-2/2, some 4/2 upper part); rare satiny luster in lower part. Faint streaked bedding. Slightly irregular thick to thin parting; hackly fracture. Rare fine dense pyritic streaks. A very thin columnar ("silky") pyrite streak at 1,936.7.
1,937.7	1,938.7	Oil shale: Dark brownish gray to some black (10YR 3/2-2/2, some 1/2); very common satiny to resinous luster. Faint very fine laminae and streaked bedding; some fine loop structures. Rare fine silty pyritic streaks. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of dark resinous oil shale from 1,938.0 feet: X-ray - illite, quartz, feldspar, pyrite, ferroan, dolomite. </div>
1,938.7	1,939.8	Oil shale: Very dark brownish gray and rare black (10YR 2/2-3/2, rare 1/2), rare satiny luster. Faint streaked bedding and very fine laminae. Rare fine dense dark to medium brownish-gray streaks--some with pyritic rims. Irregular 1-inch yellowish-buff earthy band at 1,939.4. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of yellowish-buff earthy band from 1,939.4 feet: X-ray - montmorillonite, analcite, ferroan, feldspar, quartz. </div>
1,939.8	1,941.8	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Very faint streaked bedding to very fine laminae. Irregular thick to thin parting; hackly to irregular fracture; slightly unctuous. Very rare fine grayish-brown crystalline streaks. A fine columnar pyrite streak at 1,941.6.
1,941.8	1,942.3	Oil shale: Brownish gray (10YR 4/2-5/2), dolomitic. Very faintly bedded with some very fine fairly distinct brown to tan laminae. Dense and heavy; slightly conchoidal fracture.
1,942.3	1,945.0	Oil shale: Medium to dark brownish gray (2.5Y to 10YR 4/2-3/2). Very faint streaked bedding. Irregular to fairly regular, thick to thin parting; irregular slight to coarse hackly fracture. Very rare fine columnar pyrite streaks.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,945.0	1,946.2	Oil shale: Dark to some medium brownish gray (10YR 3/2-2/2, some 4/2). Faint streaked bedding and fine laminae and some thin to 1-inch bands. Slightly irregular thick parting; slightly hackly fracture. Rare fine blebby resinous black streaks (fossil fragments?). [Sample of dark brownish-gray oil shale from 1,945.5 feet: X-ray - quartz, illite, dolomite, pyrite, feldspar, ferroan.
1,946.2	1,949.0	Oil shale: Dark brownish gray (10YR and 2.5Y 3/2, rare 2/2). Faint streaked bedding and very fine laminae. Fairly regular thin to rare thick parting; coarse to slight hackly fracture; slightly unctuous in lower part. Rare very fine dark dense streaks in upper part.
1,949.0	1,954.2	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-4/2). Faint streaked bedding and very fine laminae. Irregular to regular, thin to thick parting; irregular coarse hackly fracture; slightly unctuous. Vertical fracture with muddy coatings from about 1,949.5 to 1,950.9. A thin pinched gray silty layer at 1,954.0. [Sample of thin gray silty layer with some oil shale from 1,954.0 feet: X-ray - dolomite, marcasite, pyrite, quartz, feldspar, analcite.
1,954.2	1,956.2	Oil shale: Medium to very dark brownish gray (10YR and 2.5Y 5/2-2/2). Fairly distinct to very faint, thin to very fine laminae; some very fine to thin loop structures and displacements. Irregular to regular, thick to thin parting; slightly irregular to hackly fracture. Vertical fracture with slight vitreous black organic coatings in lower half. [Sample of medium to dark laminated oil shale from 1,955.2 feet: X-ray - illite, quartz, dolomite, feldspar, ferroan.
1,956.2	1,957.2	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, rare 2/2 upper part). Faint to some moderately distinct very fine laminae. Fairly regular thick to rare

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		thin parting; slight to coarse hackly fracture. Fine dark dense layers at 1,956.4 and 1,956.5; very rare very fine streaks elsewhere. Sample of oil shale with fine dark dense layer from 1,956.4 feet: X-ray - analcite, quartz, feldspar, ferroan, pyrite.
1,957.2	1,958.6	Oil shale: Dark and rare medium brownish gray (10YR 3/2-2/2, rare 4/2 upper part). Faint very fine laminae to very faint streaked bedding. Irregular to regular, thick to thin parting; irregular coarse hackly fracture. Some irregular discontinuous tight high angle fractures in upper part. A 1-inch pinched very finely laminated brownish-gray dolomite band at 1,957.4. A fine blebby resinous black pyritic streak at 1,958.5 (possibly fish fragments). (Sample does not look leaner than above as indicated by assay.)
1,958.6	1,960.0	Oil shale: Very dark brownish gray to some black (10YR 2/2, some 1/2 lower part). Very faint streaked bedding. Regular thick to rare thin parting; slightly hackly fracture. Rare very fine silty-textured pyrite streaks.
1,960.0	1,963.0	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2); common satiny luster, some resinous streaks near base. Very faint streaked bedding. Regular thick parting; slightly hackly fracture. Some fine dark dense lenses and streaks in upper part. Abundant <u>very</u> fine dark crystalline streaks in middle part. Rare fine silty pyritic streaks in lower part. Sample of oil shale with abundant very fine crystalline streaks from 1,961.5 feet: X-ray - quartz, illite, analcite, feldspar, pyrite, ferroan, dolomite.
1,963.0	1,964.2	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2, rare 5/2); some satiny to waxy streaks. Very faint to some moderately distinct very fine laminae and streaked bedding; common fine to 1/4-inch loop structures and displacements. Fairly regular to irregular thick parting; irregular and slightly hackly fracture.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,964.2	1,966.0	Oil shale: Dark to some medium brownish gray and rare black (10YR 2/2-3/2, some 4/2, rare 1/2), rare satiny luster. Faint very fine laminae and streaked bedding. Regular to irregular, thick to some thin parting; slight to coarse hackly fracture. A very thin resinous to waxy black organic streak at 1,964.3 (fossil fragments?); some very fine black streaks in lower part. A 3-inch brownish-gray to brown (10YR 4/2-4/3, some 5/4) irregularly bedded band at base. [Sample of thick brownish-gray to brown band from 1,965.9 feet: X-ray - dolomite, trace quartz.
1,966.0	1,967.0	Oil shale: Very dark to some medium brownish gray and black (10YR 2/2-3/2, some 4/2 and 1/2), rare satiny luster. Faint very fine laminae and streaked bedding; some fine to thin displacements and rare loop structures. Slightly irregular thick parting; slightly hackly fracture. Rare fine resinous black blebby fossil (?) streaks.
1,967.0	1,970.3	Oil shale: Dark and some medium brownish gray (10YR 3/2 and some 4/2 upper part to 3/2 and 2/2 lower part). Faint streaked bedding. Irregular to regular, thick to rare thin parting; coarse to slight hackly fracture. Rare fine pyrite streaks and blebs becoming moderately abundant in lower part.
1,970.3	1,971.6	Oil shale: Medium to rare dark grayish brown and rare tan (10YR 4/3-5/3, rare 3/2-2/2 and 6/3, some 5/1-4/1 in lower 0.2 foot). Faint streaked bedding to moderately distinct laminae; some fine loop structures and displacements. Irregular to some very regular thick parting; slightly irregular fracture. Rare fine to small dark dense to silty streaks and blebs. [Sample of grayish-brown oil shale from 1,971.3 feet: X-ray - dolomite, quartz, illite, feldspar.
1,971.6	1,973.6	Oil shale: Dark brownish to almost neutral gray (10YR 3/2-3/1). Faint streaked bedding and <u>very</u> fine laminae. Regular thick parting; slightly irregular fracture. Some zones of abundant very fine crystalline streaks.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of dark almost neutral gray shale from 1,972.1 feet: X-ray - illite, quartz, dolomite, feldspar, pyrite.
1,973.6	1,975.6	Oil shale: Dark brownish gray (10YR and 2.5Y 3/2). Faint very fine laminae and streaked bedding. Regular thick to medium parting; slightly irregular and hackly fracture. Abundant very fine crystalline streaks--commonly pyritic. Sample of oil shale with abundant very fine crystalline streaks from 1,973.9 feet: X-ray - quartz, illite, aragonite, analcite, pyrite, feldspar, calcite, dolomite.
1,975.6	1,977.9	Oil shale: Dark brownish gray (10YR 3/2). Faint streaked bedding. Regular thick to some thin parting; slightly hackly fracture. Some very fine crystalline streaks. Rare fine silty pyritic streaks becoming abundant in lower 0.3 foot. A fine tan tight sandy-textured layer at 1,977.0. Sample of oil shale with fine pyritic streaks from 1,977.7 feet: X-ray - quartz, illite, pyrite, ferroan, dolomite.
1,977.9	1,979.0	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 4/2-4/3). Faint streaked bedding. Slightly irregular thick to medium parting; slightly hackly fracture. Rare very fine silty pyritic streaks. Very rare fine round dark resinous blebs.
1,979.0	1,981.0	Oil shale: Dark to some medium brownish gray (10YR and 2.5Y 3/2, some 4/2, rare 5/2 lower part). Faint streaked bedding and very fine laminae. Fairly regular to irregular, thick to thin parting; irregular slight to coarse hackly fracture. Rare very fine silty pyritic streaks. Rare fine resinous black blebs and lenses.
1,981.0	1,982.0	Oil shale: Medium to dark brownish gray (2.5Y 5/2-4/2 upper part to 3/2-3/1 lower part). Faint very fine laminae and streaked bedding. Regular to irregular, thick to medium parting; slightly irregular to irregular coarse hackly fracture. A very small tan lense at 1,981.1. Some irregular broken core pieces.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
1,982.0	1,997.0	Claystone: Medium gray (N 5-4) with variable amounts of medium to dark brownish gray (2.5Y 4/2-3/2). Faint to some moderately distinct laminae and some irregular streaked bedding; some nearly massive zones in lower part. Very irregular thick to thin parting; very irregular coarse hackly and some conchoidal fracture; unctuous. Commonly badly broken and mixed up from handling. Some muddy fracture surfaces in lower part.
1,997.0	2,009.0	Mudstone and siltstone: Medium to light gray (N 5-6, rare 4; very slight brown tint). Faintly streaked to nearly massive; some irregular to very distorted bedding. Irregular very thick parting; irregular to fairly regular fracture. Some claystone as above in upper part. Some medium to dark brownish-gray claystone at 2,002.0-2,002.7 (grab sample gave coaly odor and trace oil in test tube).
2,009.0	2,012.0	Claystone and mudstone: Light to medium gray (N 6-5, some 4; slight brown tint). Faintly streaked to massive. Irregular parting and fracture. Broken core in upper part.
2,012.0	2,015.2	Siltstone and very fine sandstone: Light brownish gray (2.5Y 6/1-6/2). Massive with some very faint streaks. Irregular very thick parting; slightly irregular fracture. (Spot sample from 2,014.6 gave small amount of light oil in test tube.)
2,015.2	2,017.0	Mudstone: Medium to some light slightly brownish gray (2.5Y 5/1, some 4/1 and 6/1). Faint streaked bedding and some distorted and displaced laminae. Some broken core.
2,017.0	2,018.4	Siltstone and some very fine sandstone: Like 2,012.0-2,015.2 feet.
2,018.4	2,019.7	Mudstone: Medium to light gray (N 5-6; very slight brown tint). Faintly streaked; some fine very dark carbonaceous streaks in upper part. Irregular parting and fracture. Light brownish-gray tight silty dolomite in lower 0.2 foot.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,019.7	2,021.0	Mudstone: Medium to light slightly olive and some brownish gray with abundant fine to very thin black streaks (5Y 5/1-6/1, some 2.5Y 6/2-5/2, 2/2-2/1 streaks). Faintly streaked mudstone; very abundant very fine to 1/4-inch black streaks and irregular layers becoming sparse in lower half foot. Irregular parting and fracture.
2,021.0	2,021.5	Dolomite: Brownish gray (10YR 4/2-4/1). Very faint bedding inclined about 15-20 degrees. Dense; slightly irregular and conchoidal fracture.
2,021.5	2,023.0	Oil shale: Medium to dark brownish gray and some black (10YR and 2.5Y 5/2-3/2, some 2/2-1/2). Faint to moderately distinct very fine slightly irregular to contorted laminae. Some mudstone as above and below.
2,023.0	2,026.4	Mudstone: Medium to some light gray (N 5, some 6; some slight brown tint). Faint streaked bedding; some fine streaks and thick shredded stringers of oil shale as above in upper part. Very irregular parting and fracture.
2,026.4	2,026.9	Oil shale: Black to very dark brownish gray (2.5Y 1/2-2/2); some slight satiny luster. Very faint streaked bedding and very fine laminae becoming slightly curved and inclined in lower part. Slightly irregular thick parting; slightly hackly fracture. Some irregular fine to 3/4-inch siltstone streaks and stringers near top and bottom. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of black oil shale from 2,026.6 feet: X-ray - quartz, illite, dolomite, feldspar, ferroan, pyrite, kaolin.</div>
2,026.9	2,027.4	Dolomite: Medium and rare light brownish gray (10YR 5/2, rare 6/2). Very faint slightly curved to fairly regular streaks and laminae. Dense; irregular to conchoidal fracture. Some short tight high angle fractures with slight resinous brown to vitreous black coatings. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;">Sample of dense brownish-gray dolomite from 2,027.3 feet: X-ray - dolomite.</div>

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,027.4	2,028.8	Oil shale: Medium to dark brownish gray and rare black (2.5Y 4/2-3/2, some 5/2 and 2/2, rare 1/2). Faint to fairly distinct very fine laminae. Irregular to regular, thick to some thin parting; coarse hackly to slightly irregular fracture; becoming unctuous in lower part. Irregular broken contact with mudstone below.
2,028.8	2,031.0	Mudstone: Light to medium gray (N 6-5; very slight olive to brown tint). Very faintly streaked to massive; some contorted bedding. Very irregular parting and fracture; uneven sample split.
2,031.0	2,036.6	Claystone: Medium to some light slightly olive gray (5Y 5/1, some 6/1) and medium to rare dark slightly brownish gray (2.5Y 4/1-5/1, rare 3/1). Faint distorted to contorted streaked bedding to fairly regular very fine laminae. Mostly rubble and irregular core pieces; grab sampled.
2,036.6	2,040.0	Mudstone and siltstone: Medium to light gray (N 5-6, rare 4; very slight brown tint). Faint distorted to contorted, fine to very thick streaks and stringers.
2,040.0	2,048.8	Siltstone and very fine sandstone: Light brownish gray (2.5Y 6/2-6/1). Massive with some contorted gray mudstone stringers and streaks. Irregular very thick parting; slightly irregular fracture. High angle muddy fracture in lower foot. (Grab sample gave small amount of light oil in test tube.) [Sample of very fine-grained sandstone from 2,043.5 feet: X-ray - quartz, illite, feldspar, dolomite, calcite, ferroan.
2,048.8	2,052.0	Siltstone and mudstone: Light to medium slightly brownish gray (2.5Y 6/1-5/1). Faintly bedded to massive. Some broken core; uneven sample split.
2,052.0	2,057.6	Claystone: Medium to some light gray (N 5, some 6 and 4; slight brown to olive tint). Faintly laminated to very faintly bedded. Irregular to some regular, thick to medium parting; unctuous; some broken and mixed up core.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,057.6	2,058.6	Claystone: Neutral gray (N 5-4). Faintly laminated to massive. Irregular parting; very irregular coarse hackly fracture; unctuous. Oil shale as below at 2,057.6-2,057.7 and 2,058.0-2,058.1. [Sample of gray claystone from 2,058.4 feet: X-ray - quartz, illite, feldspar, calcite, dolomite, pyrite, kaolin.
2,058.6	2,059.1	Oil shale: Very dark brownish gray (2.5Y 2/2-3/2). Faint very fine laminae. Regular thick to thin parting; slight to coarse hackly fracture. Rare fish fragments (articulated vertebrae and ribs at 2,059.0). [Sample of dark brownish-gray oil shale from 2,058.7 feet: X-ray - quartz, illite, feldspar, ferroan, pyrite, calcite, dolomite.
2,059.1	2,060.1	Dolomite and oil shale: 1- to 2-inch bands of brownish-gray dolomite like 2,026.9-2,027.4 interbedded with oil shale like 2,027.4-2,028.8.
2,060.1	2,064.2	Claystone: Like 2,052.0-2,057.6. Very uneven sample split.
2,064.2	2,065.0	Oil shale: Dark to medium brownish gray (2.5Y 3/2-4/2, some 5/2-5/1). Faint distorted streaked bedding to moderately distinct very fine displaced laminae. Irregular parting and fracture. Rare fine resinous to waxy black blebs and pyritic streaks.
2,065.0	2,066.1	Mudstone: Like 2,023.0-2,026.4.
2,066.1	2,069.5	Mudstone: Medium and some light brownish gray (2.5Y 5/1 and 5/2-4/1 and 4/2, some 6/1). Faint slightly distorted to very contorted streaks and stringers. Mostly very irregular large core pieces with some irregular glossy fracture surfaces; very uneven sample split.
2,069.5	2,070.8	Shale: Medium to dark brownish gray (2.5Y 4/1 and 4/2-3/1 and 3/2). Faint irregular streaks and laminae. Very irregular thick to thin parting; irregular hackly fracture; unctuous; some rubble. Some waxy black fish (?) fragments. Fine light gray mudstone stringers in lower 0.1 foot.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,070.8	2,087.4	Mudstone: Light to medium gray (N 6-5; slight brown tint). Faintly streaked to massive. Fairly abundant very fine black carbonaceous streaks and specks in upper half. Some contorted dark brownish-gray shale stringers in lower 2 feet. Common broken to irregular core pieces in lower half.
2,087.4	2,089.0	Claystone: Medium to dark slightly brownish gray (2.5Y 5/1-3/1, some 5/2-4/2). Faint to moderately distinct laminae and rare bands. Irregular to fairly regular, thick to medium parting; irregular and some coarse hackly fracture; unctuous. Some fish (?) fragments in upper part.
2,089.0	2,094.6	Claystone: Brownish gray (2.5Y 4/1 and 4/2-5/1 and 5/2). Faintly laminated. Irregular thick to thin parting; irregular hackly fracture; unctuous. Some black fossil fragments.
2,094.6	2,096.8	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2), some satiny to resinous luster in upper part. Faint streaked bedding. Some small to 1-inch resinous black apatite (?) nodules. Rare gray mudstone stringers and streaks. <div style="margin-left: 40px;"> <div style="display: inline-block; width: 10px; height: 10px; border-left: 1px solid black; border-right: 1px solid black; margin-right: 5px;"></div> Sample of resinous black nodule with some oil shale from 2,095.1 feet: X-ray - dolomite, quartz, ferroan, analcite, illite. </div>
2,096.8	2,097.8	Oil shale: Medium to some light and dark brownish gray (10YR 4/2-5/2 and 5/3, some 3/2 and 2.5Y 5/1-6/1). Faint streaked bedding. Irregular parting and fracture; unctuous in grayer parts.
2,097.8	2,098.8	Oil shale: Medium to dark brownish gray (2.5Y and 10YR 4/2-2/2, some 4/3 upper part). Faint streaked bedding and very fine laminae. Slightly irregular thick parting; slightly hackly fracture. Few very small to fine resinous black apatite (?) lenses.
2,098.8	2,100.4	Oil shale: Medium to rare dark brownish gray (2.5Y 5/2 and 5/1-4/2 and 4/1, rare 3/1). Faint very fine laminae. Irregular thick to thin parting; irregular hackly fracture; slightly unctuous. Rare very fine black fossil fragments.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,100.4	2,103.5	Oil shale: Medium to some dark brownish gray (10YR and 2.5Y 4/2-5/2, some 3/2). Faint streaked bedding and some very fine laminae. Irregular to regular, thick to medium parting; slightly irregular to coarse hackly fracture. Some very fine brown dolomite streaks and layers in lower part.
2,103.5	2,105.0	Oil shale: Like 2,098.8-2,100.4. Mostly broken core and rubble.
2,105.0	2,107.7	Oil shale: Dark to medium brownish gray (2.5Y and 10YR 2/2-4/2), rare satiny luster. Faint to rare moderately distinct laminae and streaked bedding. Regular to irregular, thick to medium parting; slightly irregular to some coarse hackly fracture. Abundant very fine dark pyritic crystalline streaks in upper part. Some fish (?) fragments and apatite nodules in lower part.
2,107.7	2,108.3	Oil shale: Medium to very dark brownish gray (10YR 4/2 and 4/3-2/2), some resinous luster near base. Faint streaked bedding. Irregular parting and fracture. A large irregular dark brown tuff (?) nodule at 2,108.1. Irregular shredded contact with claystone below.
2,108.3	2,109.0	Claystone: Brownish-gray (2.5Y 5/2-5/1, some 4/1). Faint distorted streaked bedding. Irregular parting and fracture.
2,109.0	2,113.9	Oil shale: Medium to some dark brownish gray (10YR and 2.5Y 5/2-4/2, some 3/2 mostly in upper part). Faint streaked bedding and very fine laminae. Fairly regular to irregular, thick to thin parting; irregular coarse to sharp hackly fracture. Some broken core and rubble. Rare very fine grayish-brown crystalline laminae and streaks.
2,113.9	2,116.9	Oil shale: Medium to dark brownish gray (10YR 4/2-2/2). Faint streaked bedding and some laminae. Fairly regular thick to medium parting; slight to some coarse hackly fracture. Some fine to 3/4-inch resinous black streaks, lenses, and nodules. Rare fine pyritic streaks.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,116.9	2,120.0	Oil shale: Dark to medium brownish gray (2.5Y 3/1 and 3/2-4/1 and 4/2). Faint very fine laminae and streaked bedding. Irregular thick to very thin parting; hackly fracture; unctuous. Rubble in middle part.
2,120.0	2,121.0	Oil shale: Medium to dark brownish gray (2.5Y 5/2-3/2). Moderately distinct very fine laminae to faint streaked bedding. Slightly irregular thick to medium parting; coarse to very slight hackly fracture.
2,121.0	2,125.6	Oil shale: Medium to dark brownish gray (2.5Y 4/2-3/2, rare 2/2). Faint streaked bedding and very fine laminae. Slightly irregular thick to some thin parting; slight to rare coarse hackly fracture. Some fine black fossil fragments in upper part. Rare small to 1-inch massive brown nodules. A very thin gray silty layer at 2,121.9. One-inch hard dense grayish-brown dolomitic bands at 2,123.4 and 2,125.1. [Sample of large massive brown nodule from 2,122.4 feet: X-ray - apatite.
2,125.6	2,129.2	Oil shale: Medium to dark brownish gray (2.5Y 4/1 and 4/2-3/1 and 3/2). Faint streaked bedding and very fine laminae. Irregular thick to thin parting; hackly fracture. Some thin to 1-inch dense blebby brownish-gray to tan dolomite bands in upper part. Some broken core.
2,129.2	2,130.2	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2), some satiny luster. Faint very fine regular streaked bedding. Regular thick parting; slightly hackly fracture. Rare fish fragments.
2,130.2	2,131.1	Oil shale: Dark and some medium brownish gray (10YR 3/2-2/2, some 4/2-4/3), some satiny luster. Faint very fine regular streaked bedding. Regular to irregular thick parting; slightly hackly fracture. Abundant very fine silty pyritic blebs and streaks.
2,131.1	2,132.1	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-4/2). Faint streaked bedding. Irregular layer

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		of hard tight dark brownish-gray silty to very fine blebby-textured tuff (?) in upper 0.3 foot. [Sample of dark brownish-gray tuff from 2,131.3 feet: X-ray - analcite, feldspar, quartz, ferroan.
2,132.1	2,133.0	Oil shale: Dark to medium brownish gray (2.5Y 3/2-4/2, rare 5/2 lower part). Faint streaked bedding and some very fine laminae. Irregular thick to some thin parting; irregular coarse hackly fracture. Uneven sample split.
2,133.0	2,135.3	Oil shale: Brownish gray (2.5Y 4/2-5/2). Faint very fine laminae. Irregular thick to medium parting; irregular very coarse hackly fracture; slightly unctuous. [Sample of oil shale from 2,134.2 feet: X-ray - quartz, dolomite, illite, feldspar, ferroan.
2,135.3	2,136.6	Oil shale: Medium and rare dark brownish gray (10YR 4/2, rare 3/2). Faint streaked bedding. Irregular parting and fracture. Some fine to very small silty pyritic blebs in lower part.
2,136.6	2,137.7	Oil shale: Very dark brownish gray (10YR 2/2-3/2), rare satiny luster. Faint streaked bedding. Some thin dense dark brownish-gray streaks and lenses. [Sample of very dark oil shale from 2,137.0 feet: X-ray - quartz, illite, dolomite, feldspar, ferroan.
2,137.7	2,138.7	Oil shale: Very dark to medium brownish gray (10YR and 2.5Y 2/2 and 3/2 upper part to 3/2 and 4/2 lower part). Faint streaked bedding and very fine laminae. Fairly regular to irregular, thick to some thin parting; slight to coarse hackly fracture. Rare fine dark brownish-gray silty streaks.
2,138.7	2,140.7	Oil shale: Dark to medium brownish gray (2.5Y and 10YR 3/2-4/2). Faint streaked bedding and very fine laminae. Irregular thick to thin parting; very irregular coarse hackly fracture; slightly unctuous.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,140.7	2,141.7	Oil shale: Very dark to some medium brownish gray (10YR 2/2 upper part to 3/2 and some 4/2 lower part); common satiny to resinous luster in upper 0.4 foot. Faint streaked bedding. Irregular thick parting; slight to rare coarse hackly fracture. Some small irregular massive pyrite blebs near top. Rare very fine vitreous black organic streaks in lower part.
2,141.7	2,143.0	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 4/2). Faint streaked bedding. Slightly irregular thick to medium parting; slightly hackly fracture. Irregular high angle fracture with olive-gray silty pyritic coatings in lower inch.
2,143.0	2,145.0	Oil shale: Very dark to some medium brownish gray and black (10YR 2/2-3/2, some 4/2 and 1/2); rare satiny luster in upper part. Faint streaked bedding to some very fine laminae. Irregular to fairly regular, thick to medium parting; irregular slightly hackly fracture. A thin tight granular brownish-gray tuff layer at 2,143.9. Few fine silty pyrite streaks in lower part.
2,145.0	2,147.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Faint streaked bedding and very fine laminae. Irregular thick to some thin parting; irregular hackly fracture; uneven sample split.
2,147.0	2,149.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Faint streaked bedding. Irregular thick to medium parting; irregular fracture. Irregular vertical fracture with olive-gray silty pyritic coatings in lower half.
2,149.0	2,154.1	Oil shale: Very dark to some medium brownish gray and black (10YR 2/2-3/2, some 4/2 and 1/2), rare satiny luster. Faint streaked bedding and fine laminae to some 1-inch bands. Slightly irregular to irregular, thick to medium parting; slightly irregular to irregular and hackly fracture. Occasional fine olive-gray silty pyritic streaks, blebs, and short vermiform stringers. Distorted zone with some thin to 3/4-inch dark brownish-gray silty tuff streaks and stringers at 2,151.0-2,151.4. A very thin dense black cherty stringer with some fine pyrite at 2,152.5. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">Sample of oil shale with abundant silty tuff streaks and stringers from 2,151.2 feet: X-ray - feldspar, quartz, analcite, ferroan, pyrite, dolomite.</div>

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,154.1	2,158.0	Oil shale: Dark to medium brownish gray (10YR 2/2-4/2). Faint streaked bedding; slightly wavy and distorted in parts. Irregular thick parting; slightly hackly fracture. Some fine to thin, brown to brownish-gray dolomitic streaks and lenses. Rare very fine dense to silty-crystalline streaks and blebs. [Sample of dark brownish-gray oil shale from 2,155.2 feet: X-ray - quartz, illite, dolomite, feldspar, analcite.
2,158.0	2,159.3	Oil shale: Dark brownish gray to rare black (10YR 3/2-2/2, rare 1/2). Faint streaked bedding and some laminae. Slightly irregular thick parting; slightly hackly fracture.
2,159.3	2,167.0	Claystone (oil shale): Medium to dark slightly brownish and olive gray (2.5 and 5Y 4/1-3/1, some 4/2). Faint streaked bedding to nearly massive. Irregular thick to some thin parting; irregular very coarse hackly fracture; slightly unctuous. Faintly layered brown dolomitic band at 2,161.9-2,162.0. Some muddy broken core pieces in lower part. [Sample of gray claystone from 2,162.6 feet: X-ray - quartz, illite, dolomite, feldspar, pyrite, ferroan.
2,167.0	2,168.0	Oil shale: Dark to some medium brownish gray (2.5Y 3/2, some 2/2 and 4/2). Faint streaked bedding and some laminae. Irregular thick parting; irregular fracture. Rare very fine silty streaks.
2,168.0	2,169.0	Oil shale: Medium to dark brownish gray (2.5Y 4/2-3/2). Faint streaked bedding. Irregular thick to medium parting; irregular and some coarse hackly fracture; slightly unctuous.
2,169.0	2,170.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faintly laminated. Irregular parting and fracture.
2,170.0	2,173.0	Oil shale: Dark to medium brownish gray (2.5Y 3/2-4/2). Faint streaked bedding. Irregular thick to some thin parting; very irregular hackly fracture; slightly to moderately unctuous. Some rubble; uneven sample split.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,173.0	2,174.4	Oil shale: Medium and some dark brownish gray (10YR 4/2, some 3/2). Faint streaked bedding and some laminae. Irregular thick parting; irregular fracture. Sample of brownish-gray oil shale from 2,173.7 feet: X-ray - dolomite, quartz, illite, feldspar.
2,174.4	2,179.0	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2 and 3/1-4/2 and 4/1, some 2/2 and 5/2). Faint streaked bedding to faint and some fairly distinct laminae. Irregular to fairly regular, thick to thin parting; irregular hackly fracture. A 0.1-foot dense massive brownish-gray dolomite band at 2,176.0. Very large massive buff to light brownish-gray mudstone lenses (or very irregular layers?) at 2,178.6-2,178.9. Occasional fine black blebs (fecal pellets?) in middle part. Sample of dark slightly brownish gray shale with rare fine black blebs from 2,176.5 feet: X-ray - quartz, illite, ferroan, pyrite, feldspar, dolomite. Sample of dark oil shale with medium brownish-gray laminae from 2,177.1 feet: X-ray - quartz, illite, dolomite, feldspar, pyrite. Sample of very large buff mudstone lens from 2,178.7 feet: X-ray - dolomite, some quartz.
		Orange marker (from oil-yield histogram).
2,179.0	2,181.0	Oil shale: Dark brownish gray with some thin to thick medium brownish-gray to rare buff layers (10YR and 2.5Y 3/2-2/2, some 4/2-5/2, rare 6/2-7/2). Faint laminae and streaked bedding with some faint to rare distinct bands. Irregular to fairly regular, thick to rare thin parting; slightly irregular to some coarse hackly fracture. Very rare fine black blebs. Rare fine silty streaks. Sample of irregularly layered brownish-gray to buff band from 2,179.9 feet: X-ray - dolomite, quartz, calcite. Sample of dark brownish-gray oil shale from 2,180.3 feet: X-ray - quartz, illite, feldspar, calcite, pyrite, dolomite.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,181.0	2,183.0	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 4/2). Faint very fine laminae and streaked bedding. Fairly regular to irregular thick to some thin parting; slightly irregular to coarse hackly fracture. A very small brown nodule at 2,181.4. Few fine prismatic calcite streaks at 2,182.1. Abundant very fine ostracodal streaks in lower part. [Sample of dark ostracodal oil shale from 2,182.2 feet: X-ray - quartz, illite, calcite, feldspar, pyrite.
2,183.0	2,185.5	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 5/2 upper part). Faintly laminated. Irregular very thick parting; slightly irregular and conchoidal fracture; heavy. Some ostracodal streaks and zones. Rare very small brown to tan nodules. [Sample of hard heavy brownish-gray oil shale from 2,184.6 feet: X-ray - calcite, quartz, dolomite.
2,185.5	2,188.8	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2 mostly in lower part). Faint streaked bedding and very fine laminae. Slightly irregular thick to medium parting; slightly irregular to some hackly fracture. Thin sparry grayish-brown dolomite band with pyritic streaks at 2,186.2 and a 3/4-inch dense massive band at 2,187.6. Rare fine resinous black blebs in lower part.
2,188.8	2,191.2	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 4/2-3/2). Faint streaked bedding. Fairly regular to irregular, thick to some thin parting; slightly irregular to hackly fracture. Abundant ostracods in upper part. Fine brittle vitreous black organic layer at 2,189.2. A 3-inch dense grayish-brown dolomite band with some irregular tar-stained fractures at 2,190.7. A 1-inch brownish-gray lens with resinous black rims near base. [Sample of brownish-gray lens with resinous black rims from 2,191.2 feet: X-ray - apatite, dolomite, quartz, pyrite.
2,191.2	2,193.4	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 2/2). Faint streaked bedding. Irregular to fairly

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		regular, thick to medium parting; irregular coarse to slight hackly fracture. Some very fine resinous black streaks (some are probably fish fragments). Some very fine irregular discontinuous fractures with olive-gray pyritic fillings.
2,193.4	2,195.6	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faint streaked bedding. Irregular to regular, thick to rare thin parting; irregular coarse to slight hackly fracture. Some very fine irregular fractures with pyritic fillings in upper part.
2,195.6	2,196.6	Oil shale: Very dark brownish gray to some black (10YR 2/2, some 1/2). Faint streaked bedding. Slightly irregular thick to some thin parting; irregular coarse to slight hackly fracture. Some very fine resinous black streaks (fossil fragments?). Rare short fractures with olive-gray pyritic fillings. [Sample of very dark oil shale from 2,196.4 feet: X-ray - illite, quartz, dolomite, ferroan, feldspar.
2,196.6	2,197.6	Oil shale: Medium to very dark brownish gray (10YR 4/2-2/2). Faint streaked bedding in thick to thin lighter and darker zones. Slightly irregular thick parting; irregular fracture. Some very fine silty streaks in lighter zones. Rare olive-gray silty streaks and fracture fillings. [Sample of medium brownish-gray oil shale from 2,197.3 feet: X-ray - quartz, illite, dolomite, feldspar.
2,197.6	2,200.6	Oil shale: Dark to medium brownish gray and some black (10YR 2/2-4/2, some 1/2 lower part). Faint streaked bedding. Irregular thick to some thin parting; irregular coarse hackly fracture. Diagonal glossy shear surface at 2,200.3.
2,200.6	2,203.3	Oil shale: Medium and some dark brownish gray (10YR and 2.5Y 4/2-5/2, some 3/2). Faint very fine regular laminae in upper part to very fine streaked bedding in lower part. Irregular to fairly regular thick parting; fairly regular to slight and some coarse hackly fracture. Abundant very fine light brownish-gray

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		slightly silty streaks in lower part. Olive-gray zone with some fine pyritic streaks at 2,201.8-2,202.0.
		Sample of olive-gray oil shale with pyritic streaks from 2,201.8 feet: X-ray - quartz, illite, dolomite, feldspar, pyrite.
		Sample of brownish-gray oil shale with very fine light silty streaks from 2,202.6 feet: X-ray - quartz, illite, dolomite, feldspar, ferroan.
2,203.3	2,204.6	Oil shale: Very dark brownish gray to black (10YR 2/2-1/2, some 3/2 upper part). Very faint streaked bedding. Irregular to regular, thick to rare thin parting; irregular coarse hackly fracture. Rare very fine resinous black streaks.
2,204.6	2,206.0	Oil shale: Medium to some dark brownish gray (10YR 4/2, some 3/2). Faint streaked bedding. Irregular thick parting; irregular very coarse hackly fracture. Very fine brittle vitreous black organic streak at 2,205.3.
2,206.0	2,207.6	Oil shale: Dark brownish gray (10YR 3/2-2/2). Faint streaked bedding. Irregular thick to thin parting; coarse to sharp hackly fracture. Diagonal glossy shear surface at 2,206.3.
2,207.6	2,209.5	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2, some 5/2 and 2/2). Faint streaked bedding and some very fine to thin laminae. Irregular thick to medium parting; irregular to coarse hackly fracture. Some very fine dark gray silty streaks. Vertical fracture with olive-gray silty pyritic coatings at 2,208.8-2,209.0.
2,209.5	2,211.5	Oil shale: Brownish gray (10YR and 2.5Y 4/2-5/2). Faint streaked bedding. Irregular thick to some thin parting; irregular coarse hackly fracture. Two diagonal fractures with rough, fine blebby-textured surfaces and olive-gray silty patches in upper half foot.
2,211.5	2,213.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Faint streaked bedding. Irregular to fairly regular, thick to thin parting; hackly to irregular fracture. Rare low angle fractures with rough silty olive-gray crusts.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,213.0	2,215.8	Oil shale: Brownish gray (10YR 4/2, some 5/2 upper part). Faint streaked bedding. Irregular thick parting; slightly irregular to very coarse hackly fracture. Some very fine light brownish-gray silty streaks becoming rare in lower part.
2,215.8	2,220.0	Oil shale: Medium to some dark brownish gray (10YR 4/2, some 3/2 mostly in upper part). Very faint streaked bedding. Irregular thick to some thin parting; irregular hackly fracture; slightly unctuous. A 1-inch tight gray silty band at 2,219.6; common fine lacy stringers down to 2,219.9. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of gray silty band from 2,219.6 feet: X-ray - mixed layer clay, pyrite, analcite, magnesite. </div>
2,220.0	2,221.0	Oil shale: Dark brownish gray (10YR 3/2). Very faint streaked bedding. Irregular thick to thin parting; irregular slight to coarse hackly fracture. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of dark brownish-gray oil shale from 2,220.3 feet: X-ray - quartz, illite, dolomite, feldspar, magnesite. </div>
2,221.0	2,228.0	Oil shale: Medium and some dark brownish gray (10YR 4/2, some 3/2, rare 5/2-5/3). Faint streaked bedding to very fine laminae and rare thin to 1-inch bands. Irregular to fairly regular, thick to thin parting; irregular hackly fracture; slightly unctuous in parts. Rare glossy shear surfaces. A 1-inch gray slightly silty claystone band at 2,223.4. A 1-3/4-inch dense grayish-brown dolomite band at 2,224.9. A thin irregular brownish-gray to buff silty stringer at 2,226.5. Some very fine resinous black fossil fragments in lower part. <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 20px;"> Sample of brownish-gray to buff silty stringer from 2,226.5 feet: X-ray - feldspar, ferroan, illite, quartz. </div>
2,228.0	2,230.0	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 2/2 and 4/2). Faint streaked bedding and some very fine laminae. Irregular to regular, thick to some thin parting; irregular coarse hackly fracture;

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		slightly to moderately unctuous. A 1-inch brown to tan very fine blebby-textured band with fine irregular and displaced oil-shale layers at 2,229.4. Rare very small black <u>cherty</u> nodules in lower part.
2,230.0	2,234.0	Oil shale: Medium to dark brownish gray (2.5Y 4/2-3/2, some 5/2 upper part). Very faint very fine laminae and streaked bedding. Irregular thick to thin parting; irregular coarse hackly fracture; slightly unctuous. Some thick firm dolomitic zones in upper part. Rare fine to very small brown to black blebs (coprolites?).
2,234.0	2,234.5	Dolomite: Medium to some light brownish gray (10YR 5/2, some 4/2 and 6/2). Massive to very faintly laminated. Hard and dense; slightly conchoidal to irregular fracture. Some very tight vertical and diagonal fractures with slight varnish-like coatings. [Sample of hard dense brownish-gray dolomite from 2,234.1 feet: X-ray - dolomite, some quartz.
2,234.5	2,236.5	Oil shale: Medium to dark brownish gray (2.5Y and 10YR 4/2-3/2). Faint streaked bedding and very fine laminae. Irregular thin to thick parting; irregular hackly fracture. Fine gray silty lacy to vermiform stringers at 2,235.0-2,235.1 (like 2,219.6 feet). Very rare fish scales and other fossil fragments.
2,236.5	2,239.7	Oil shale: Dark to medium brownish gray and some grayish brown (10YR 3/2-5/2, some 4/3-5/3). Very faint to some moderately distinct laminae and streaked bedding. Irregular thick to thin parting; irregular to hackly fracture. Firm grayish-brown dolomitic zone at 2,237.1-2,237.6; some thin to 0.1-foot dolomitic bands elsewhere. A thin buff silty and slightly earthy stringer at top. Rare very small brown nodules. [Sample of buff silty stringer with some oil shale from 2,236.5 feet: X-ray - kaolin, ferroan, feldspar, illite, quartz.
2,239.7	2,241.0	Oil shale: Dark to medium and some light brownish gray (2.5Y 3/2-5/2, some 6/2-6/1). Faint to moderately

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From	To	Description
		distinct laminae and some thin light brownish-gray bands. Irregular thick to thin parting; very irregular hackly fracture. Some fine ostracodal (?) streaks.
2,241.0	2,242.0	Oil shale: Dark to medium brownish gray (2.5Y 3/2-4/2, some 5/2). Faint and rare moderately distinct laminae to very faint streaked bedding. Irregular thick to some thin parting; irregular coarse hackly fracture. Thin grayish-brown dolomite band at 2,241.9.
2,242.0	2,243.0	Oil shale: Dark to medium brownish gray (2.5Y to 10YR 3/2-4/2). Faint streaked bedding and very fine laminae. Irregular to fairly regular, thick to some thin parting; coarse to slight hackly fracture. Few very thin to 3/4-inch grayish-brown dolomite layers.
2,243.0	2,246.0	Oil shale and dolomite: Dark brownish-gray oil shale (10YR to 2.5Y 3/2) and grayish-brown to tan dolomite (10YR 4/3-6/3 and 6/2). Faintly laminated and streaked oil shale with abundant thin to some 1-inch dolomite layers. Irregular to regular, thick to thin parting; irregular hackly fracture. Rare very fine black fossil fragments.
2,246.0	2,250.0	Oil shale: Brownish gray (2.5Y 4/2, very rare 5/2). Faint streaked bedding and very fine laminae. Irregular to fairly regular, thick to some thin parting; coarse to some sharp hackly fracture; moderately to slightly unctuous. Very rare fine black to brown blebs.
2,250.0	2,251.0	Oil shale: Medium to some dark brownish gray (2.5Y to 10YR 4/2, some 3/2 lower part). Very faint very fine laminae. Irregular to regular, medium to thin parting; coarse hackly fracture; slightly unctuous. Very rare fish scales.
2,251.0	2,254.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2). Faint streaked bedding. Irregular to some regular, thick to thin parting; irregular coarse to some sharp hackly fracture; slightly to moderately unctuous. Very faintly laminated light brownish-gray

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		to buff dolomite band at 2,251.1-2,251.3; medium to light grayish-brown massive dolomite with vertical fractures with varnish-like coatings at 2,251.6-2,251.8; rare thin dolomite layers in lower part. A 3/4-inch gray-buff to light gray, silty and slightly earthy band at 2,253.8 with fine lacy to vermiform stringers extending one inch into shale below. <div style="margin-left: 40px;">Sample of gray-buff to light gray band from 2,253.8 feet: X-ray - kaolin, ferroan, illite, feldspar.</div>
2,254.0	2,255.4	Oil shale: Medium to some dark brownish gray (2.5Y 4/2, some 3/2 and 5/2). Faint streaked bedding; some moderately distinct displaced laminae. Irregular thick to rare thin parting; irregular hackly fracture.
2,255.4	2,257.0	Oil shale: Medium to dark brownish gray (2.5Y and 10YR 4/2-3/2). Faint streaked bedding and very fine laminae. Irregular thick to medium parting; irregular fracture. High angle fractures with muddy coatings and rare varnish-like coatings throughout. A very thin buff silty stringer at 2,256.0 with fine stringers extending 1/2-inch into shale below.
2,257.0	2,258.0	Oil shale: Very dark brownish gray to some grayish brown (10YR 2/2-3/2, some 4/3). Very faint streaked bedding with some irregular grayish-brown stringers and bands. Irregular to fairly regular, thick to rare thin parting; slightly irregular to coarse hackly fracture; slightly unctuous. <div style="margin-left: 40px;">Sample of very dark oil shale from 2,257.5 feet: X-ray - quartz, illite, feldspar, ferroan, pyrite, kaolin.</div>
2,258.0	2,259.0	Oil shale: Dark brownish gray to some grayish brown (10YR to 2.5Y 3/2, some 4/3-5/3). Faint streaked bedding and very fine laminae with some grayish-brown bands. Irregular to regular, thick to medium parting; irregular coarse hackly fracture; slightly unctuous.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,259.0	2,261.0	Oil shale: Dark to medium brownish gray (2.5Y 3/2-4/2). Faint very fine laminae and streaked bedding. Irregular thick to rare thin parting; irregular coarse hackly fracture; slightly unctuous. Two-inch brownish-gray to tan dolomite bands at top and 2,260.3.
2,261.0	2,262.4	Oil shale: Dark to medium brownish brownish gray (2.5Y and 10YR 3/2-4/2). Faint very fine laminae and streaked bedding. Irregular thick to some thin parting; very irregular coarse hackly fracture. A 1/2-inch firm gray slightly silty claystone band at 2,261.9. [Sample of thin gray claystone band from 2,261.9 feet: X-ray - quartz, illite, feldspar.
2,262.4	2,263.5	Dolomite and shale: Light brownish-gray dolomite (10YR and 2.5Y 6/2-6/1) and medium to dark brownish-gray shale (10YR 4/2 and 4/1-3/2 and 3/1). Thin to 2-inch massive dolomite bands separated by very thin to 1-inch shale zones. Some irregular tight high angle fractures through dolomite bands.
2,263.5	2,265.0	Shale and some dolomite: Shale as above with some thin to 1-inch dolomite bands; a 3-inch irregular fractured light brownish-gray to buff dolomite band at 2,264.6. Some fish (?) fragments. [Sample of slightly brownish gray shale from 2,264.5 feet: X-ray - quartz, illite, dolomite, feldspar, kaolin, pyrite.
2,265.0	2,266.0	Shale and dolomite: Medium brownish-gray shale (2.5Y 5/2 and 5/1-4/2 and 4/1) and light brownish-gray to buff dolomite (10YR 6/2 and 6/1-7/2 and 7/1). Very faintly laminated shale with thin to 1-inch, slightly silty to blebby dolomite layers. A very thin soft unctuous gray clay layer at 2,265.6. [Sample of light brownish-gray slightly silty to blebby dolomite from 2,265.9 feet: X-ray - dolomite, quartz, feldspar.
2,266.0	2,267.0	Oil shale: Medium to dark brownish gray (2.5Y 5/2 and 5/1-3/2). Faint streaked bedding and very fine laminae. Irregular thick to thin parting; irregular coarse hackly fracture. Abundant fine light gray silty streaks in upper part.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,267.0	2,268.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faint very fine laminae and streaked bedding. Irregular to fairly regular, thick to some thin parting; irregular coarse hackly fracture. Rare very fine black fossil fragments.
2,268.0	2,269.2	Oil shale: Dark to some medium brownish gray (10YR 3/2-2/2, some 4/2-4/3). Very faint streaked bedding and some fine to thin laminae; irregular to regular; thick to thin parting; coarse hackly to slightly irregular fracture. Rare very small irregular resinous black blebs in lower part. Sample of resinous black blebs from 2,268.8 feet: X-ray - quartz.
2,269.2	2,270.1	Oil shale: Dark to medium brownish gray (10YR and 2.5Y 3/2-5/2, some 3/1-4/1). Faintly streaked and laminated to massive. Regular to irregular, thick and some thin parting; hackly to irregular and conchoidal fracture. Some fine to thin grayish-brown dolomite laminae and streaks in upper 0.2 foot.
2,270.1	2,270.6	Dolomite: Medium to light brownish gray (2.5Y 5/2 and 5/1-6/2-and 6/1). Massive with rare faint streaks. Dense; conchoidal fracture.
2,270.6	2,275.0	Claystone: Medium to dark gray (N 4-3; slight brown tint). Very faintly bedded. Irregular thick to some thin parting; very irregular coarse hackly fracture.
2,275.0	2,278.0	Shale: Medium to dark slightly brownish gray (2.5Y to 10YR 4/1-3/1, some 4/2-5/2). Very faintly bedded. Irregular thick to thin parting; irregular hackly fracture.
2,278.0	2,281.0	Oil shale: Dark and some medium brownish gray (10YR and 2.5Y 3/2, some 4/2 upper part). Very faint streaked bedding. Irregular thick to thin parting; irregular hackly fracture. A 2-inch grayish-brown massive dolomite band at 2,278.5; faintly streaked medium to light grayish-brown dolomite at 2,279.0-2,279.4; 1-inch dolomite band at 2,279.7.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		[Sample of dark brownish-gray shale from 2,279.9 feet: X-ray - quartz, illite, pyrite.
2,281.0	2,282.6	Shale: Medium to some dark slightly brownish gray (2.5Y 4/1, some 10YR 3/1-3/2). Faint streaked bedding and very fine laminae. Irregular thick to thin parting; irregular hackly fracture. Irregular medium to light brownish-gray dolomite bands with faint displaced laminae at 2,281.4 (2-inch) and 2,282.4 (1-inch).
2,282.6	2,285.0	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faint streaked bedding and very fine laminae; rare fine to thin moderately distinct brown laminae. Irregular to very regular, thick to thin parting; irregular to hackly fracture. Some broken core; uneven sample split.
2,285.0	2,286.3	Oil shale: Medium grayish brown to dark brownish gray and some tan to buff (10YR 4/3-3/2, some 5/3-7/2). Faint to distinct laminae and bands; some small displacements. Fairly regular to irregular thick parting; irregular fracture. [Sample of grayish-brown oil shale from 2,285.4 feet: X-ray - dolomite, quartz, illite.
2,286.3	2,289.0	Shale: Medium to dark slightly brownish gray (2.5Y 4/1-3/1, some 4/2-3/2). Very faintly bedded. Regular to irregular, thick to very thin parting; hackly fracture; slightly unctuous.
2,289.0	2,292.2	Oil shale: Medium to dark brownish gray (10YR and 2.5Y 4/2-3/2). Very faint streaked bedding. Irregular to very regular, thick to very thin parting; irregular coarse to fine hackly fracture; unctuous. A small round dark brown nodule at 2,290.0. A 1-inch brownish-gray dolomite band at 2,291.4 and 2-1/2-inch band at base. [Sample of small dark brown nodule from 2,290.0 feet: X-ray - apatite.
2,292.2	2,294.2	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2, some 2/2). Faint streaked bedding. Regular to irregular, thin to very thick parting; hackly to

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		slightly irregular fracture; unctuous in upper part. Firm dolomitic zone with some fine fish (?) fragments at 2,293.3-2,293.6.
2,294.2	2,297.2	Oil shale: Dark brownish gray to medium grayish brown (10YR and 2.5Y 3/2-5/2 and 5/3). Very faint to fairly distinct, very fine to thin laminae; rare fine to small displacements. Regular to irregular, thin to thick parting; irregular hackly fracture; unctuous. Rare fine olive-gray silty streaks and discontinuous fracture fillings. A 1-inch faintly laminated light brownish-gray dolomite band at 2,295.8. A 1-inch gray slightly silty band at 2,296.1. [Sample of gray band from 2,296.1 feet: X-ray - quartz, illite, ferroan, pyrite.
2,297.2	2,299.9	Oil shale: Medium to some dark brownish gray (2.5Y 5/2 and 4/2 upper part to 10YR 4/2 and some 3/2 lower part). Faint very fine laminae; rare fine displacements. Irregular thick parting; irregular fracture; moderately to slightly unctuous. Some very fine light silty streaks. A 1-inch faintly laminated dolomite band at top. Irregular vertical fracture with olive-green silty pyritic coatings at 2,298.1-2,298.5. [Sample of oil shale with some very fine light silty streaks from 2,298.8 feet: X-ray - quartz, illite, dolomite, ferroan, feldspar.
2,299.9	2,300.4	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 4/2). Faint very fine laminae. Shaly to papery parting; fine hackly fracture.
2,300.4	2,302.0	Oil shale: Medium to some dark brownish gray (10YR 4/2, some 3/2). Faint very fine laminae and streaked bedding. Irregular thick to rare thin parting; irregular to coarse hackly fracture. Some discontinuous fractures with olive-gray pyritic coatings. A 1-inch firm light slightly brownish gray claystone band at 2,300.6. A 1-inch dense grayish-brown dolomite band at 2,301.7.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,302.0	2,303.7	Oil shale: Medium to dark brownish gray (10YR 4/2 and 4/1-3/2). Faint streaked bedding and very fine laminae. Irregular thick to some papery parting; irregular hackly fracture. Some fractures with olive-green pyritic coatings in upper part. Muddy broken core in upper part; uneven sample split.
2,303.7	2,305.0	Oil shale: Medium to dark brownish gray (2.5Y to 10YR 4/2-3/2). Moderately distinct to faint very fine laminae and streaked bedding; 1-inch contorted zone near top. Irregular parting and fracture. Abundant very fine light brownish-gray to medium gray silty streaks in upper part becoming rare in lower part. <div style="margin-left: 40px;"> { Sample of oil shale with abundant light brownish-gray to gray silty streaks from 2,303.9 feet: X-ray - quartz, dolomite, feldspar. </div>
2,305.0	2,307.0	Oil shale: Medium and rare dark brownish gray (10YR 4/2, some 5/2-5/3, rare 3/2). Faint very fine laminae. Irregular thick to rare thin parting; slightly irregular to coarse hackly fracture. Rare very fine brownish-gray to gray silty streaks in upper part.
2,307.0	2,308.3	Oil shale: Medium to some dark brownish gray (10YR 4/2, some 3/2). Faint very fine laminae and streaked bedding. Irregular medium to thin parting; hackly fracture; slightly unctuous.
2,308.3	2,310.0	Oil shale: Medium and some dark brownish gray (10YR to 2.5Y 4/2, some 3/2, rare 5/2). Faint very fine laminae and streaked bedding. Irregular to fairly regular, thick to rare thin parting; coarse hackly to irregular fracture. Broken core in upper 0.8 foot.
2,310.0	2,310.5	Oil shale: Medium brownish gray and olive gray (2.5Y 4/2-5/2, and 5Y 4/1 and 4/2-5/1 and 5/1). Faint streaked bedding. Abundant fine gray silty streaks. A 3/4-inch light brownish-gray (10YR 6/2) wavy dolomite band at top.
2,310.5	2,312.0	Oil shale: Medium to some dark brownish gray (2.5Y and 10YR 4/2, some 5/2 and 3/2). Faint streaked

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		bedding. Irregular thick parting; irregular to slightly conchoidal fracture. Some very fine light silty streaks.
2,312.0	2,313.0	Oil shale: Medium to some dark brownish gray and grayish brown (10YR 4/2, some 3/2 and 4/3). Faint streaked bedding to very fine laminae. Irregular thick to some thin parting; slightly irregular to some hackly fracture. [Sample of oil shale from 2,312.2 feet: X-ray - quartz, dolomite, illite, feldspar, ferroan.
2,313.0	2,314.2	Oil shale: Medium to dark brownish gray (10YR 4/2-3/2). Faint very fine laminae. Irregular thick to medium parting; irregular to coarse hackly fracture. Abundant thin to 3/4-inch displaced grayish-brown dolomite layers.
2,314.2	2,315.4	Oil shale: Medium and some dark brownish gray (10YR and 2.5Y 4/2, some 3/2). Faint very fine laminae. Slightly irregular thick to medium parting; slightly irregular and hackly fracture.
2,315.4	2,315.9	Oil shale and dolomite (?): Oil shale as above and below interbedded with thin slightly irregular medium to light grayish-brown, dense to slightly blebby dolomite layers.
2,315.9	2,316.2	(Algal dolomite): Brownish gray and some brown (10YR 4/2-5/2, some 5/3-5/4). Very irregular and displaced stringers. Slightly silty. Some small irregular slightly porous patches and thin streaks. [Sample of brownish-gray slightly silty dolomite from 2,316.0 feet: X-ray - dolomite, quartz, feldspar.
2,316.2	2,318.0	Oil shale: Dark brownish gray (10YR to 2.5Y 3/2). Faint streaked bedding and very fine laminae. Slightly irregular thick to thin parting; slightly irregular to hackly fracture; unctuous. Some very irregular dolomite stringers near top and 1-inch finely laminated and streaked band at 2,316.5. Very rare fish (?) fragments.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,318.0	2,319.1	Dolomite and oil shale: Light to dark brownish gray (10YR 6/1-3/1 and 3/2). Thick to thin dense faintly bedded dolomite layers grading to inter-bedded oil-shale zones. A 1-inch tan slightly blebby dolomite band at 2,318.3 with a thin irregular dark gray silty pyritic layer in middle. Sample of dolomite with dark gray pyritic layer from 2,318.3 feet: X-ray - dolomite, pyrite, ferroan.
2,319.1	2,320.3	Oil shale: Dark brownish gray (10YR and 2.5Y 3/2). Faint streaked bedding and very fine laminae. Irregular to regular, medium to thin parting; hackly fracture; unctuous. A thin light brownish-gray dolomite band at 2,320.2.
2,320.3	2,320.5	Dolomite: Medium to light brownish gray (10YR 5/2 and 5/1-6/2 and 6/1). Massive; very fine blebby textured. Some vertical fractures with slight resinous brown coatings.
2,320.5	2,320.8	Oil shale: As Above. Some fine dolomite streaks near top.
2,320.8	2,321.1	Dolomite: Brownish gray (10YR 5/2 and 5/1-4/2 and 4/1). Very faintly streaked and layered. Hard and dense; conchoidal to irregular fracture. Irregular broken core pieces at base.
2,321.1	2,324.3	Oil shale: Dark brownish gray (10YR to 2.5Y 3/2). Very faint streaked bedding and very fine laminae. Regular to irregular, thick to thin parting; slight to coarse hackly fracture. Very small fish vertebrae and other fragments at 2,322.6. Broken core at 2,321.1-2,321.9 and 2,323.2-2,323.6.
2,324.3	2,325.3	Dolomite: Medium to some light brownish gray (10YR 4/1 and 4/2 to 2.5Y 5/2 and some 6/2). Thin to 4-inch very fine blebby-textured bands interbedded with some thin to 1-inch oil-shale zones as above and below. Hard and tight.
2,325.3	2,326.9	Oil shale: Like 2,321.1-2,324.3. Very rare fish(?) fragments and small black blebs.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,326.9	2,328.0	Oil shale: Dark to medium brownish gray (10YR 3/2-4/2). Faint streaked bedding and very fine laminae. Slightly irregular thick parting; irregular slightly hackly fracture. Very abundant mashed ostracods (?) on parting surfaces. Rare small black blebs.
2,328.0	2,330.0	Oil shale: Dark to some medium brownish gray (10YR 3/2, some 4/2). Faint streaked bedding and very fine laminae. Slightly irregular thick to rare thin parting; slightly irregular to some coarse hackly fracture. Abundant ostracods. Some fine to small black to dark brown blebs (coprolites). [Sample of coprolites from 2,328.0-2,330.0 feet: X-ray - apatite.
2,330.0	2,331.0	Oil shale: Dark to some medium brownish gray (10YR and 2.5Y 3/2, some 4/2). Faint streaked bedding and very fine laminae. Regular thick to some thin parting; slightly irregular to rare coarse hackly fracture. Abundant ostracods. Rare coprolites.
2,331.0	2,332.6	Claystone: Dark slightly brownish gray (2.5Y 3/1). Very faint streaked bedding. Irregular to regular, thick to some thin parting; hackly to irregular fracture. Abundant ostracods. A 1-inch brownish-gray dolomite band at top. [Sample of dark gray claystone from 2,331.9 feet: X-ray - quartz, illite, calcite, pyrite, dolomite, ferroan.
2,332.6	2,335.3	Mudstone: Medium slightly brownish gray (10YR 4/1-5/1). Very faintly streaked to massive. Slightly irregular thick parting; irregular to conchoidal fracture; hard and dense. Abundant ostracods. [Sample of hard massive brownish-gray mudstone from 2,334.4 feet: X-ray - quartz, illite, dolomite, pyrite, analcite.
2,335.3	2,342.0	Mudstone and claystone: Dark to medium slightly brownish gray (10YR 3/1-4/1). Very faint streaked bedding. Regular to irregular, thick to rare thin parting; slightly irregular and conchoidal to coarse hackly

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		fracture; slightly unctuous in lower part. Abundant ostracods. A fine soft unctuous gray-buff clay layer at 2,341.9. [Sample of fine gray-buff clay layer from 2,341.9 feet: X-ray - illite, kaolin, feldspar, quartz.
2,342.0	2,344.0	Oil shale: Dark to some medium brownish gray (2.5Y 3/2, some 4/2). Very faint streaked bedding. Irregular to regular, thick to some thin parting; coarse hackly fracture. Abundant ostracods. [Sample of dark brownish-gray oil shale from 2,343.5 feet: X-ray - quartz, illite, pyrite, feldspar, calcite.
2,344.0	2,345.0	Mudstone: Dark to medium slightly brownish gray (10YR 2/1 and 3/1 upper part to 3/1 and 4/1 lower part). Very faint streaked bedding. Irregular thick to medium parting; coarse hackly to irregular fracture. Abundant ostracods.
2,345.0	2,348.0	Mudstone and claystone: Like 2,335.3-2,342.0.
2,348.0	2,350.0	Mudstone and shale: Medium to dark brownish gray (2.5Y and 10YR 4/2 and 4/1-3/2 and 3/1). Faint streaked bedding. Irregular to fairly regular, thick to some thin parting; coarse hackly to irregular fracture. Abundant ostracods. A 1-inch massive grayish-brown dolomite band at 2,348.9.
2,350.0	2,353.6	Mudstone: Medium slightly brownish to neutral gray (2.5Y 4/1-5/1 and N 4-5). Faintly streaked and mottled. Irregular parting and fracture; hard and dense. Abundant ostracods and very rare clam fragments in upper part.
2,353.6	2,354.7	Dolomite: Buff and gray buff to rare brownish gray (10YR 7/2-7/1, rare 6/2-5/2). Massive with some faint irregular banding. Slightly irregular to conchoidal fracture; hard and dense. Some ostracodal streaks and layers. A 1-inch band of medium to dark brownish-gray oil shale at top and a thin layer at 2,353.8.

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		Sample of buff dolomite from 2,354.1 feet; X-ray - dolomite, trace quartz.
2,354.7	2,355.0	Oil shale and mudstone: Medium to dark brownish gray (10YR 4/2-3/2 and 2.5Y 5/2-5/1). Oil shale with some fine tan to buff dolomite streaks in upper 2 inches; massive mudstone with abundant ostracods in lower part. A thin grayish-brown dolomite band at base. Rare fine coprolites in oil shale.
2,355.0	2,356.0	Siltstone and fine sandstone: Medium to light slightly brownish gray and neutral gray (2.5Y 4/1-6/1 and N 6), very calcareous. Mottled to irregularly streaked with very distorted fine brownish-gray silty stringers. Irregular parting and fracture. Fairly abundant muscovite flakes.
2,356.0	2,358.8	Sandstone and siltstone: Yellowish buff (2.5 to 5Y 7/2-8/2 and 8/1), <u>calcareous</u> to dolomitic; fine grained. Distorted bedding to massive. Abundant fine dull black carbonaceous streaks from 2,357.0-2,357.8; rare elsewhere.
2,358.8	2,360.0	Sandstone: Nearly white to buff (2.5Y and 10YR 9/1-8/2), fine to medium grained, calcareous. Massive with some faint thick banding. Some very fine tan earthy specks. Grading to yellowish-buff siltstone in lower 0.2 foot.
2,360.0	2,362.5	Siltstone, very fine sandstone, and mudstone: Gray buff to medium slightly brownish gray and neutral gray (2.5Y 8/1-4/1 and N 4). Distinctly streaked in thick regular to irregular lighter and darker zones. Rare carbonaceous streaks.
2,362.5	2,363.5	Claystone: Medium gray and slightly brownish gray (N 4-5 and 2.5Y 4/1-5/1). Faint streaked bedding. Irregular thick parting; irregular very coarse hackly fracture; slightly unctuous. Broken core.
2,363.5	2,367.7	Mudstone: Medium to dark brownish gray (2.5Y and 10YR 5/2 and 5/1-3/2). Faintly streaked to mottled with

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Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		blebby to silty limestone patches. Abundant ostracods. Abundant 1- to 2-inch clam shells (some hinged pairs).
2,367.7	2,369.0	Sandstone and siltstone: Medium to light gray (N 5-7; slight brown tint in darker parts). Faintly mottled to very distorted streaked bedding.
2,369.0	2,372.0	Mudstone: Medium to light and some dark slightly brownish gray (10YR and 2.5Y 4/1-6/1, some 3/1-2/1 lower part). Faintly mottled to irregularly streaked. Some carbonaceous plant trash in lower part. A thin to 1-inch vermiform stringer of light gray sandstone from 2,371.3 to 2,371.8.
2,372.0	2,373.2	Mudstone and claystone: Medium to light slightly brownish gray (2.5Y and 10YR 6/1-4/1, some 4/2). Massive to very faintly bedded. Broken core in lower part.
2,373.2	2,374.0	Dolomite and shale: Tan to grayish-brown dolomite (10YR 6/3-5/3) and medium to some dark brownish-gray shale (10YR 5/2-4/2, some 3/2). Irregular massive dolomite layers at 2,373.2-2,373.4 and 2,373.8-2,374.0; shale with faint slight wavy streaked bedding in middle. Fairly abundant white to buff specks in dolomite (some may be <i>Goniobasis</i> fragments). Some clam (?) fragments in shale.
2,374.0	2,375.0	Mudstone: Medium gray (N 5, some very slight brown tint). Irregularly bedded to finely streaked and laminated with light gray siltstone; massive blebby dolomitic mudstone in upper 0.1 foot.
2,375.0	2,377.0	Mudstone, siltstone, and some shale: Medium to dark brownish gray and gray buff to light gray (10YR 5/1 and 5/2-3/1 and 3/2, and 6/1-7/1 and N 7). Faint streaked bedding to distinct irregular layers and stringers in very thick darker and lighter zones. Rare clam fragments. Broken core in shaly zones.

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Laramie Energy Research Center, Laramie, Wyoming

May 5, 1971

LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,377.0	2,377.7	Sandstone: Light gray (N 6-7); very slight brown tint), fine grained, calcareous. Massive to faintly streaked. Fairly abundant mica.
2,377.7	2,379.6	Mudstone, siltstone, and some claystone: Medium to light slightly brownish gray and neutral gray (10YR 4/1-7/1 and N 5-7). Irregularly streaked and layered. Some irregular thin to 1-inch tan dolomite layers.
2,379.6	2,379.9	Claystone: Dark brownish gray (10YR and 2.5Y 3/2). Very faint streaked bedding. Irregular thick to thin parting; coarse hackly fracture. Some fine brown to tan blebs. Rare clams. (Grab sample gave coaly odor and very small amount of oil in test tube.) Sample of dark brownish-gray claystone from 2,379.9 feet: X-ray - quartz, illite, kaolin, pyrite, calcite, feldspar.
2,379.9	2,380.7	Sandstone: Light gray (N 7-8, some 6 near top and bottom), very fine grained, slightly calcareous. Faintly mottled and streaked to massive.
2,380.7	2,386.5	Mudstone and claystone: Medium slightly brownish and olive gray (2.5 to 5Y 5/1, some 4/1). Faintly streaked to some massive. Very irregular parting and fracture. Some irregular light gray siltstone streaks, patches, and layers. A 0.5-foot orange-buff massive slightly earthy band (?) at 2,384.0 with some fine lacy crystalline fracture fillings; rare large to small isolated masses with <u>indistinct</u> outlines elsewhere. Sample of buff band with some fine crystalline fracture fillings from 2,383.9 feet: X-ray - siderite; some quartz, barite, illite, kaolin.
2,386.5	2,389.0	Siltstone and very fine sandstone: Light gray, slightly calcareous. Finely streaked with rare massive bands. Some mudstone and claystone as above. Broken core in lower foot.
2,389.0	2,391.0	Very fine sandstone and siltstone: Very light gray buff to medium slightly brownish gray. Faintly mottled to irregularly streaked.

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Cora samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
2,391.0	2,391.5	Mudstone: Very dark to medium brownish gray (10YR 2/2 and 2/1-4/2 and 4/1). Faint irregular streaked bedding. Abundant very fine coaly streaks near top.
2,391.5	2,394.1	Very fine sandstone and mudstone: Gray buff to medium slightly olive and brownish gray. Mottled to irregularly streaked and layered. Some orange-tan to buff nodules and irregular thick layers in lower part (like 2,384.0 feet).
2,394.1	2,395.0	Mudstone: Like 2,391.0-2,391.5. Very rare very fine coaly streaks. Mostly rubble.
2,395.0	2,398.4	Mudstone, siltstone, and very fine sandstone: Gray buff to light and some medium slightly olive gray. Faintly mottled to irregularly streaked and layered. Some orange-buff mottling and irregular layers in lower part.
2,398.4	2,399.1	Mudstone: Like 2,391.0-2,391.5. Some fine coaly streaks.
2,399.1	2,399.9	Siltstone and very fine sandstone: Slightly brownish gray to gray-buff. Faintly mottled and variegated.
2,399.9	2,403.5	Mudstone and claystone: Medium to dark brownish gray (10YR and 2.5Y 5/2 and 5/1-3/2 and 3/1). Faint irregular streaked bedding. Irregular thick to some thin parting; very irregular to coarse hackly fracture. Some fine coaly streaks in upper part. Abundant clam fragments and rare <i>Goniobasis</i> in lower part.
2,403.5	2,408.5	Siltstone and fine sandstone: Medium to very light gray and gray-buff. Finely laminated to irregularly streaked; some small crossbedding. Some very fine black carbonaceous streaks in lower part.
2,408.5	2,409.0	Mudstone and claystone: Medium to rare dark slightly brownish gray. Faint streaked bedding.
2,409.0	2,411.8	Shale: Medium to dark brownish gray (2.5Y and 10YR 4/2-3/2). Very faint streaked bedding; some thin grayish-brown layers in upper part. Irregular thick

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LITHOLOGIC DESCRIPTION OF SAMPLES SUBMITTED FOR ASSAY

Core samples from Atlantic Richfield-Mobil Figure 4 Corehole 31-1 (Con.)

From	To	Description
		to thin parting becoming fairly regular in lower part; irregular hackly fracture. Abundant clams and rare Goniatites in middle part; few thin irregular limestone layers.
2,411.8	2,412.5	Coal and coaly shale: Black to very dark brownish gray, vitreous to subvitreous. Shaly to papery parting; brittle. Some vertical fractures with papery calcite crusts. Some very fine olive-green silty pyritic streaks.
2,412.5	2,417.0	Claystone and mudstone: Dark to medium brownish gray to neutral gray. Rubble and some irregular coarse pieces; crumbly in upper part becoming firm in lower part. Grab sampled.
2,417.0	2,420.0	Mudstone: Medium gray, massive, firm. Mostly irregular core pieces and angular chunky rubble. Grab sampled.

Bottom of core.

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